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**POST OFFICE**

# *tele* **communications**

**JOURNAL**

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**SIXPENCE**

**SUMMER 1968**

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2 AMP TOGGLE SWITCH



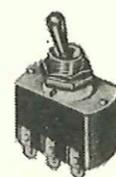
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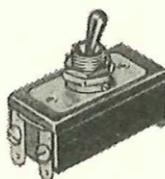
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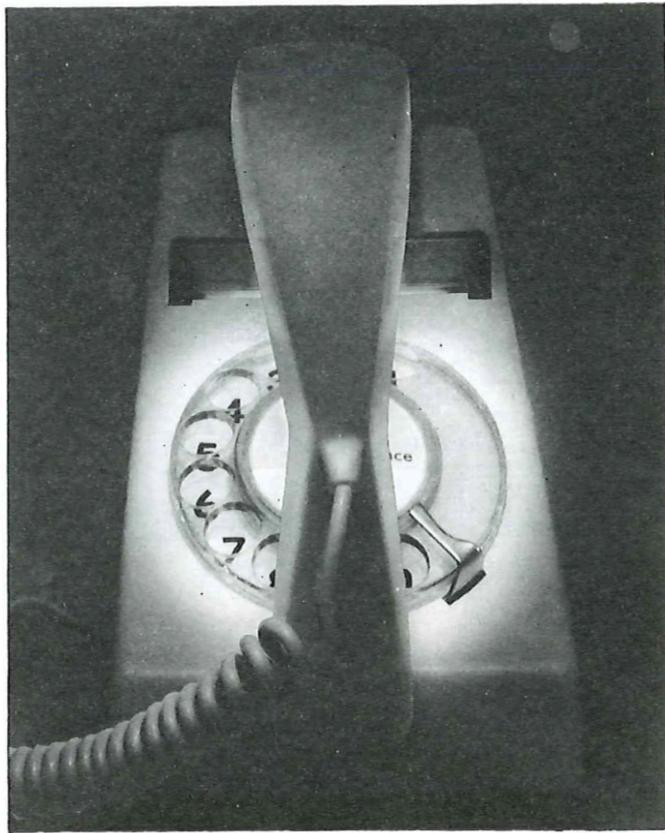
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# STC Telecommunications



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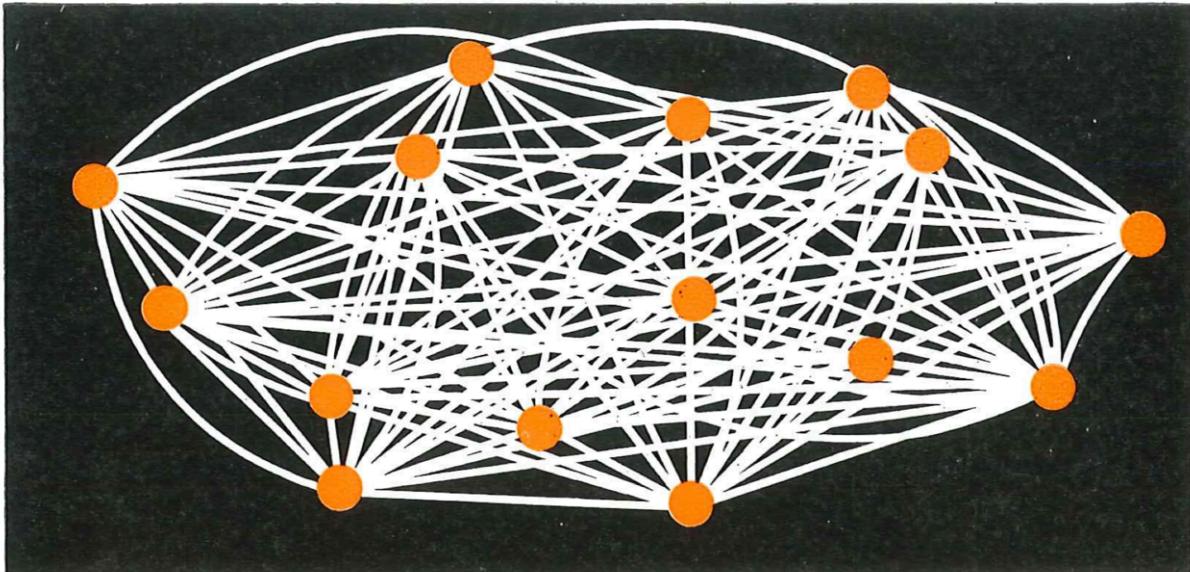
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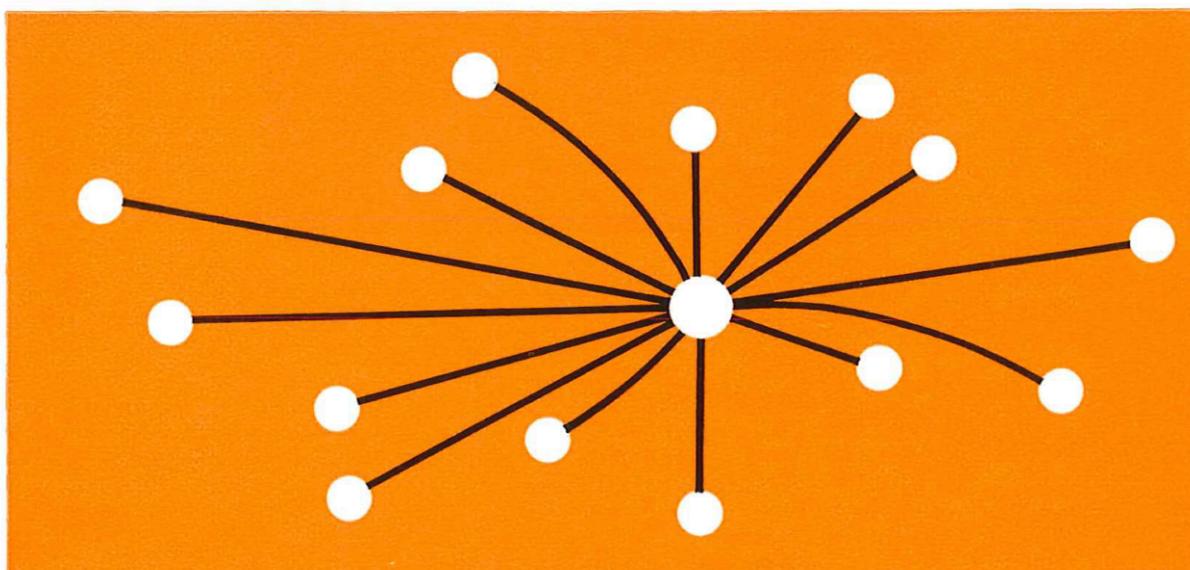
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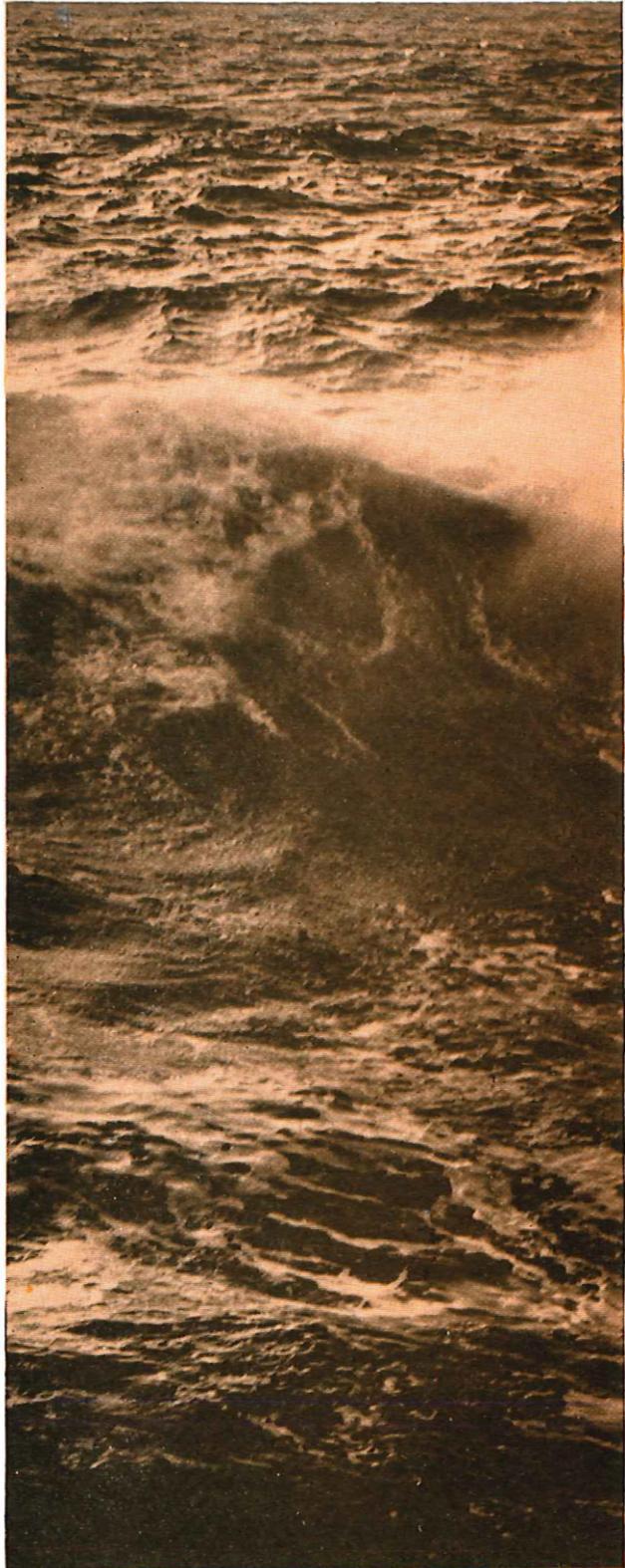
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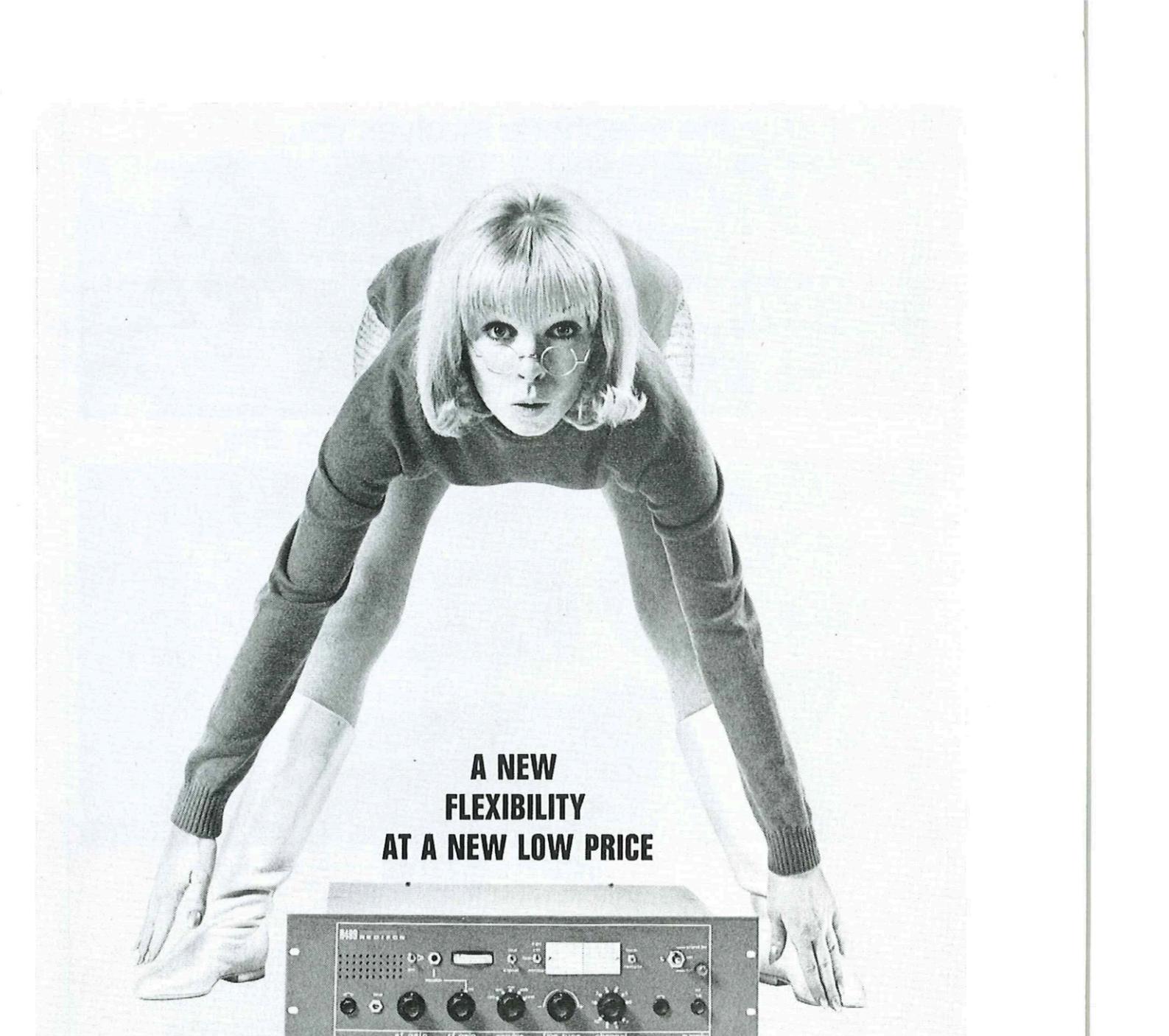
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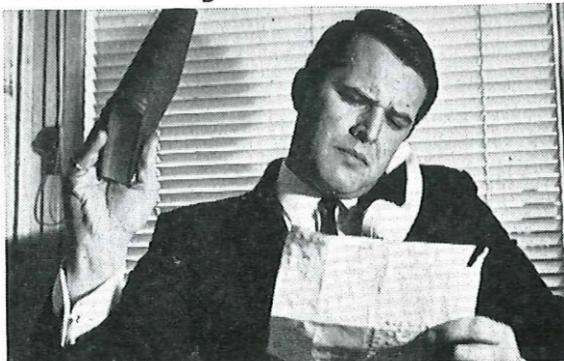
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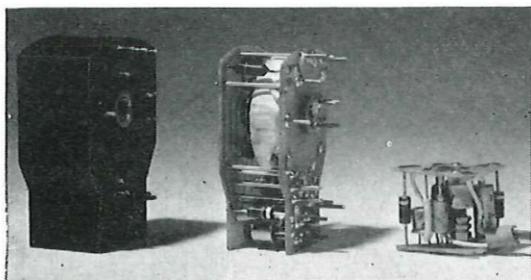
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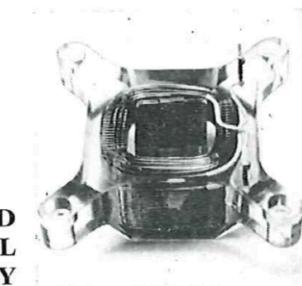
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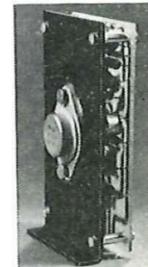
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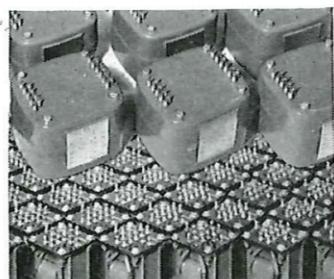
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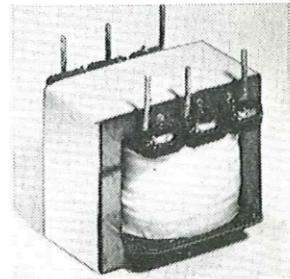
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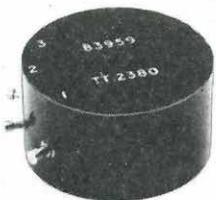
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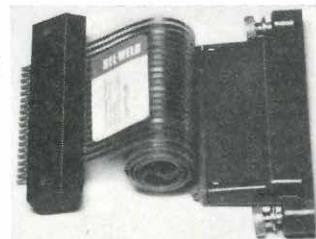
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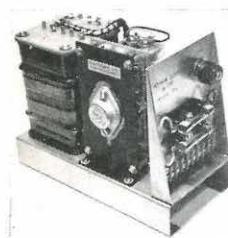
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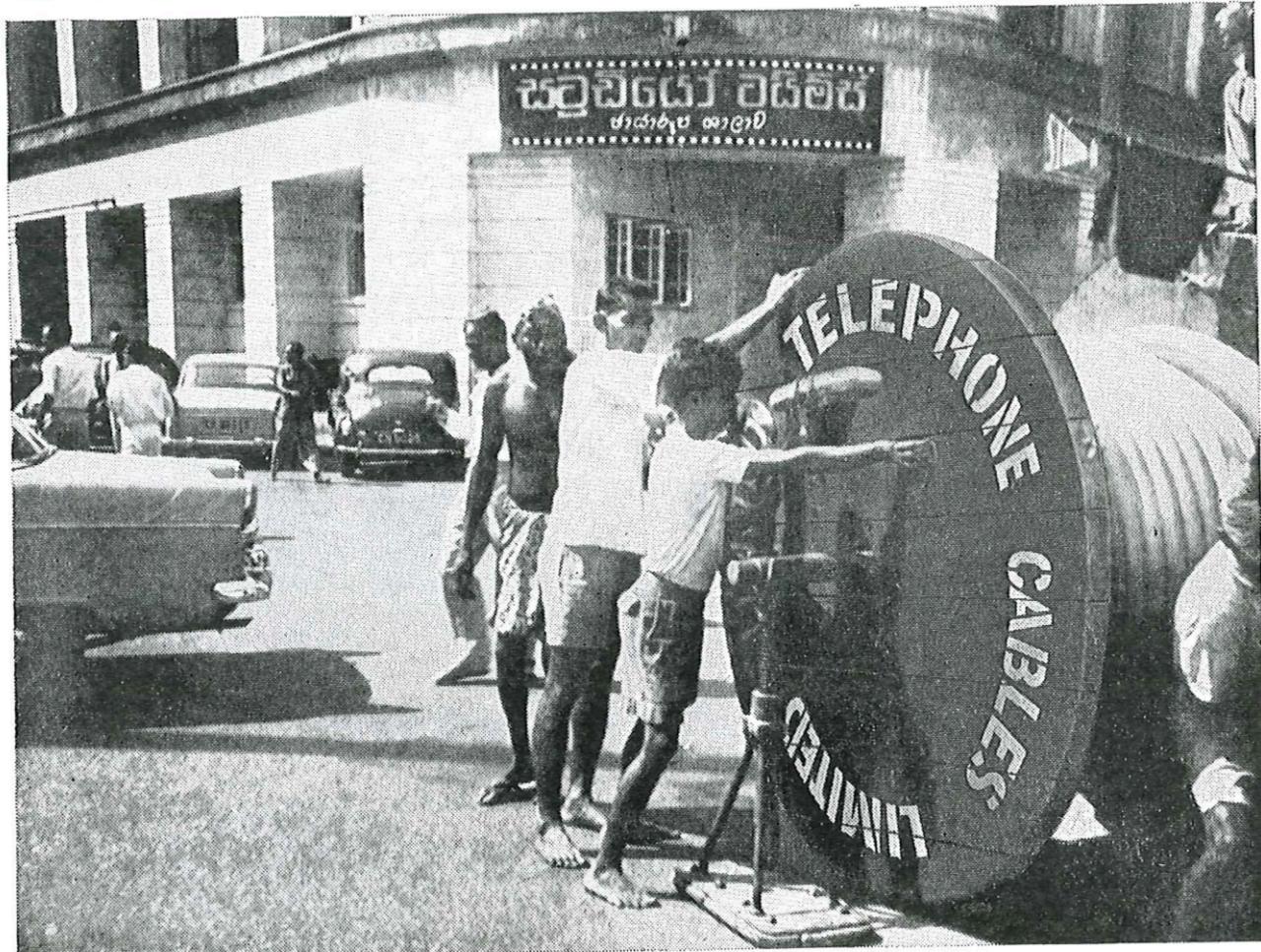
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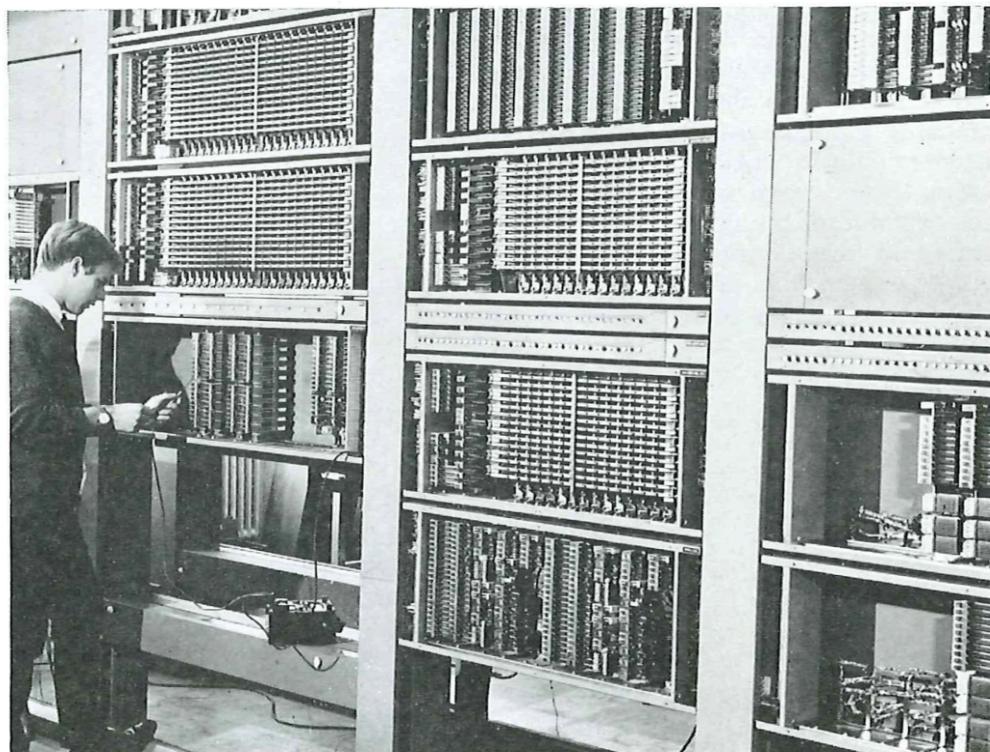
# Post Office Telecommunications Journal

Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

## The New Transit Network

By R. B. Leigh

**This article describes the new trunk telephone transit network which will bring many benefits, not only to the Post Office but also the subscribers**



The new network will depend largely for its success on the crossbar system. Here is a general view of a crossbar exchange, showing an engineer carrying out tests.

All photographs illustrating this article are reproduced by courtesy of Standard Telephones and Cables Ltd.

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Vol. 20 Summer 1968 No. 2

**T**RIALS are shortly to be held which will set the stage for the introduction throughout the country of a new trunk telephone transit network.

When the trials have been completed—by early 1969—the first of a series of new trunk transit switching centres will be brought into service. Later, other switching centres will be added to the system so that by 1975 any subscriber in Britain using STD will be able to dial his own calls to any other subscriber anywhere in the country.

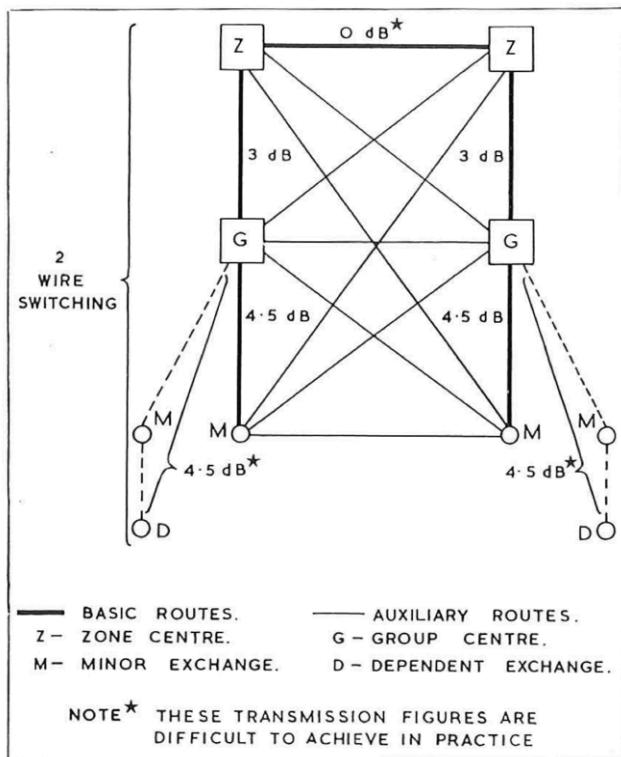
**OVER**

A tester carries out an inspection of a selector switch to ensure uniform contact between bank bars and selector contact springs, before assembly to multiswitch.

The new transit network\* will, in addition, help the Post Office to cope more efficiently with the constantly-increasing amount of trunk traffic, speed the connection of calls, improve their quality and improve and expand the International Subscriber Dialling system. It will also save manpower and should lead to increased productivity, with cash savings to both the Post Office and its customers.

The present trunk switching and transmission system was set up nearly 40 years ago and has satisfactorily answered most requirements. With the introduction of Subscriber Trunk Dialling in 1958, however, the trunk system began to change from a predominantly manual to a predominantly STD system and was no longer entirely suitable.

Under the manual routing system, each trunk group centre collects trunk traffic from the minor exchanges in its group and is, in turn, connected to a zone centre exchange serving the group centres in its zone. Each zone centre has direct



\*The network and its basic principles were outlined in an article by Messrs. H. A. Longley and A. J. Thompson in the Summer, 1961 issue of the journal.

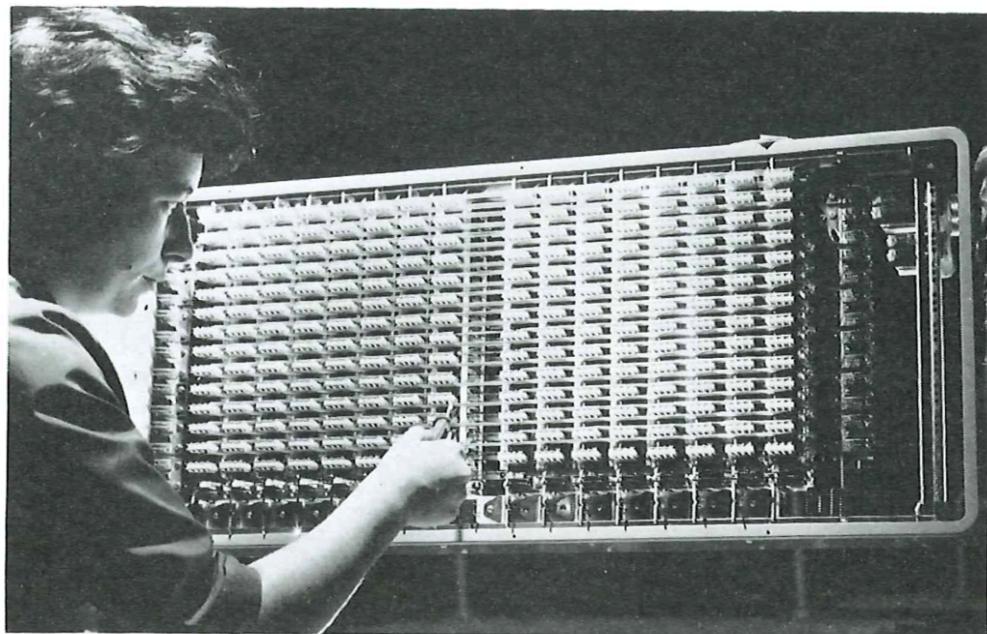


circuits to every other zone centre so that any two minor exchanges can be connected by the links between minor and group, group and zone, and zone and zone.

Minor exchanges are normally connected to their group centre by a direct route but some exchanges—usually the more remote—reach their group centre via an intermediate minor exchange and are known as dependent exchanges. Only a small proportion of calls is, of course, routed over the full basic network from group centre through two zone centres to a distant group centre. Most of the traffic is completed over auxiliary routes from one group centre direct to another or through an intermediate group centre.

Under STD conditions these auxiliary routes

**This diagram shows the existing trunk system**



Conducting wires of multi-lages between selectors on multi-switch after final inspection. This operation allows multiswitch to operate on the basis of 50 lines per bank.

will continue to carry the bulk of the traffic on existing exchange and line plant, and the routing plan will be based on group switching centres. Controlled by register-translators (RTs) at the originating group switching centre (GSC), calls are routed direct to the objective GSC or via not more than one intermediate GSC.

The small proportion of trunk calls which require more than two trunk links in tandem cannot, however, be satisfactorily routed over this type of network for a number of reasons.

First, on an automatic call a subscriber expects to receive ringing tone or some other supervisory tone soon after he has completed dialling the required number. But those trunk calls which have to be switched through a number of intermediate exchanges before they reach their destination would, as a result of the comparatively slow operation of the Strowger system, encounter an unacceptable delay between completion of dialling and receipt of tone.

Second, on such multi-link calls the existing system gives too wide a variation in the overall transmission quality.

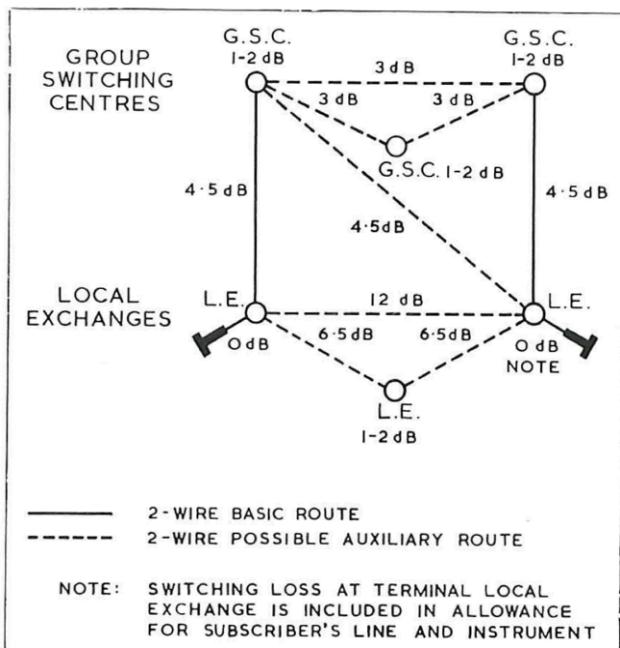
Third, originating RTs have a limited capacity both for providing routing digits (five or six, according to the type of RT) and for providing translations (mostly 240 to 300, excluding the drum type RT). But multi-link calls will require more routing digits than five or six and for full

STD translations should be available for all the other 695 number groups.

All these limitations will be overcome in the new transit system which will consist of a special network of four-wire trunk circuits and four-wire

## OVER

### Two-wire switched trunk and junction network for subscriber trunk dialled traffic.





Wire wrapping with the aid of a pneumatic gun on a platine, integral part of a crossbar multiswitch.

transit switching centres (TSCs), affording better and more uniform transmission quality and almost eliminating tone delay by means of high-speed switching and signalling equipment.

The constraints imposed by the limited routing and code capacity of originating RTs will be nullified by the provision of "own exchange only" RTs at each transit switching centre.

Thirty-seven TSCs are planned, nine of which will be fully interconnected. The fully interconnected TSCs will be known as main switching centres (MSCs) and the remainder as district switching centres (DSCs). Direct routes will be provided from a GSC to its home DSC and between a DSC and its home MSC. These and the routes between MSCs will constitute the basic transit network.

Routes may also be provided where justified to cut out one or more switching centres. These will constitute the auxiliary network and include such routes as GSC to GSC; GSC to "foreign" DSC/MSC; or DSC to "foreign" DSC/MSC. Facilities for automatic alternative routing, to improve circuit exploitation, will be provided at each type of switching centre.

The RT at the originating GSC controls the progress of calls over the trunk network and is connected in circuit until the call is finally set up, when it is released to handle other calls.

Register translators at each transit centre will switch the call through to the next link in the chain of connections. When this is done the transit register translator will be released and the control of the call will revert to the register translator at the originating GSC.

When the controlling RT routes a call to a transit centre, it will call into service a multi-frequency coder which will send out multi-frequency digit signals, based on using two out of six frequencies. These can be sent over the line very much more quickly than Strowger pulses. In fact, the whole of the subscriber's number can be sent in less than one second.

The controlling RT and its associated switching equipment selects a route to the required DSC, where a register translator is seized which sends back a "transit proceed to send" signal. By means

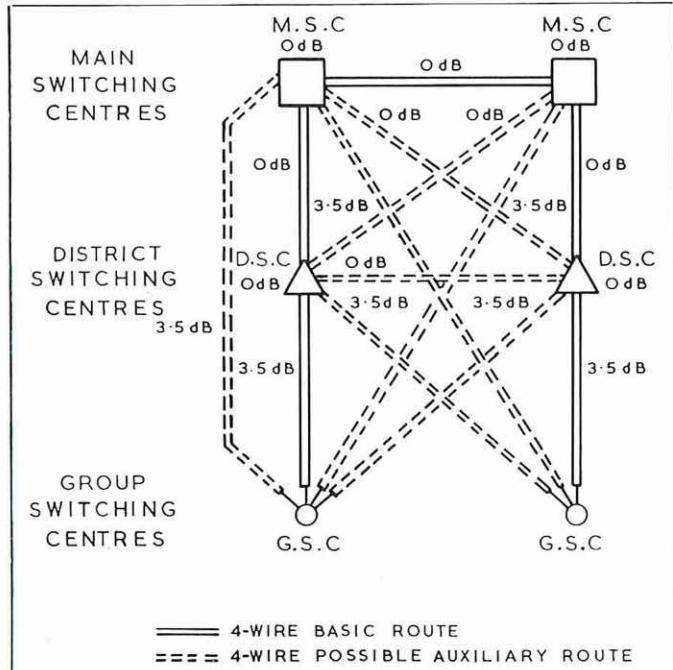
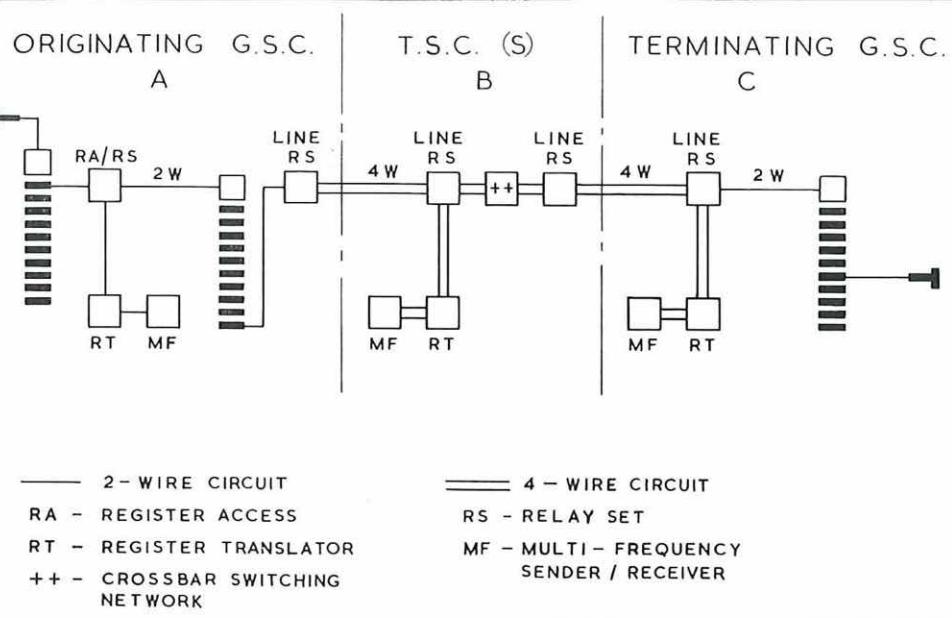


Diagram of a 4-wire switched trunk transit network with multi-frequency signalling.



**Left:** This diagram shows the path of a transit call under the new system.

**Below:** A diagram showing standard transmission loss with 4-wire switching at an automanual centre

of multi-frequency signals the national code of the required number group is then sent to the transit register translator which selects the route and the call is switched through.

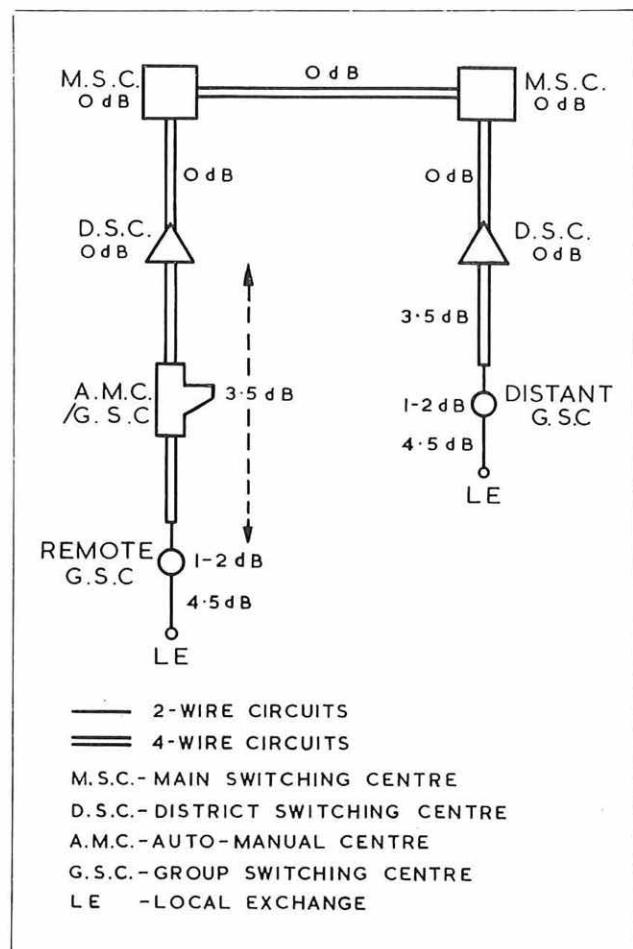
At the distant GSC a decoder is seized and this sends back a terminal "proceed to send" signal to the controlling RT. The local number is then sent in multi-frequency form which the decoder converts to Strowger pulses to operate the switching equipment at the GSC and at the required minor exchange. The call may pass through up to four transit switching centres.

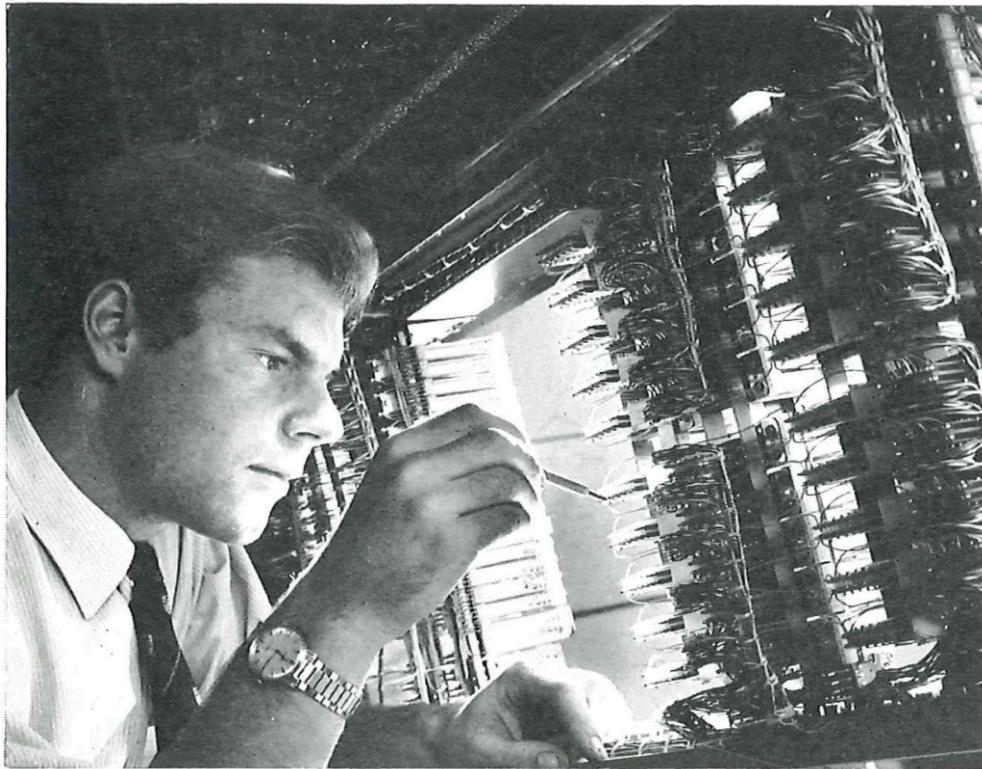
Earlier it had been proposed to base the switching at transit centres on motor uniselectors, but since then it has been decided to use a crossbar system.

There will be two classes of trunk route outgoing from a GSC or TSC—"high usage" routes and "fully provided" routes. A high usage route will have a small number of circuits compared with the traffic offered to it and the consequent heavy loading will result in more efficient use of the circuits. Calls arriving when all the circuits are engaged will be directed to an alternative route.

Fully-provided routes will be circuited on a more generous basis in the same way as in the present network and calls arriving when all circuits are engaged will receive engaged tone or an announcement. Most large routes and all basic

**OVER**





An STC engineer checks one of the contacts on a multiple relay of a crossbar exchange.

routes will be fully provided, high usage working being mainly used to increase the efficiency of the small auxiliary trunk route. To prevent calls overflowing from route to route in an uncontrolled manner, calls overflowing from a high usage route will be directed to a particular fully provided route.

Studies are being made to determine the basis of provision and to establish the most effective way of exploiting automatic alternative routing. At TSCs the first alternative route will be obtained by changing the translation within the TSC by route busy relays associated with the first choice route. At the originating GSC where Strowger switches will usually be employed, either the translation will be changed by the originating RT or the early outlets of the Strowger switch will be connected to the first choice route and the later outlets joined to the alternative route.

Even when full STD is available there will still be a residual demand for operator service in trunk switching and although general-purpose auto-manual switch boards to handle all classes of traffic calling for operator assistance may be used, it seems certain that an auto-manual centre will not be justified economically at every GSC. Some auto-manual centres will therefore serve remote

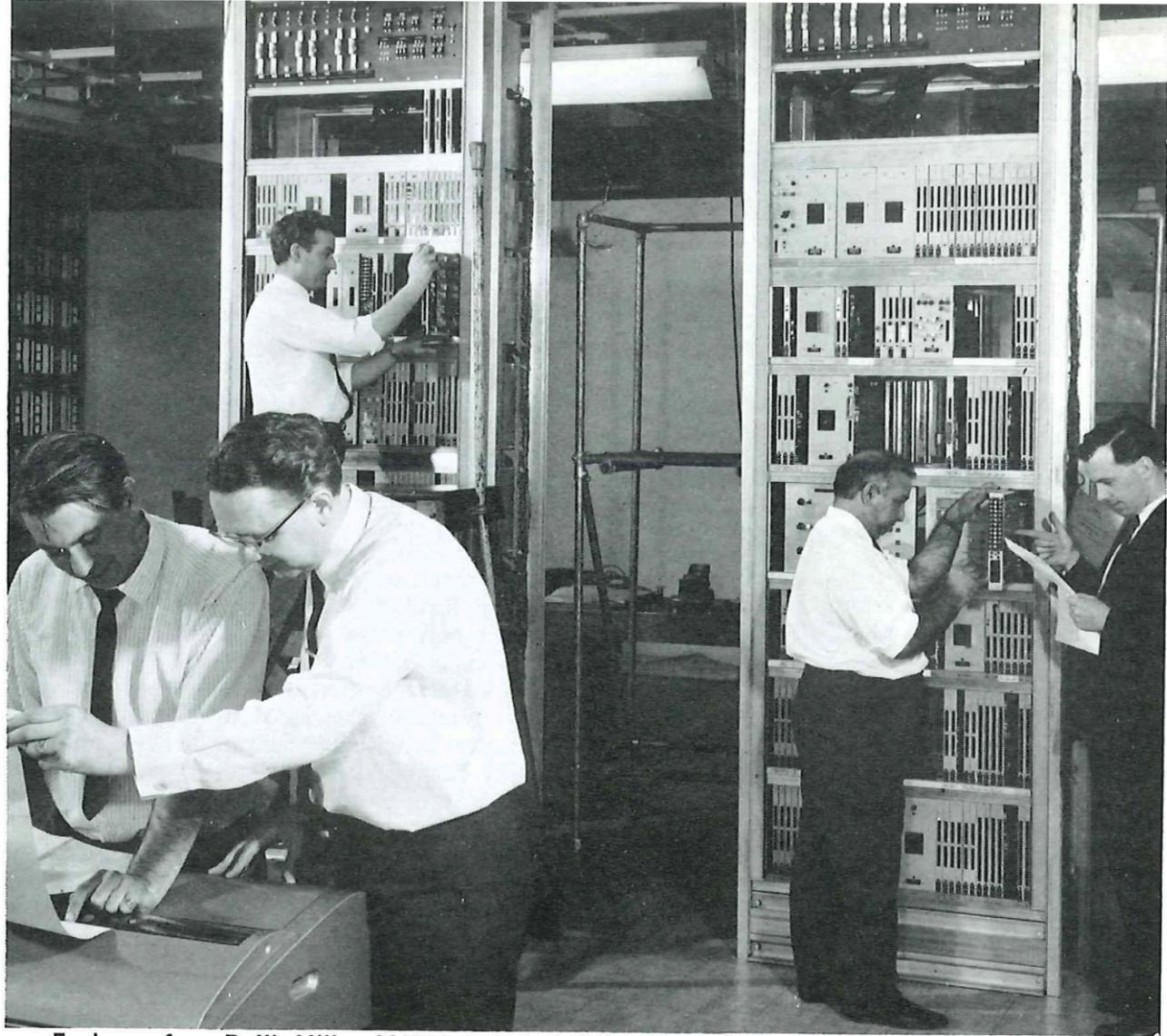
GSCs and in order to conform to the prescribed transmission limits these centres will be capable of four-wire switching when necessary.

Traffic trials using multi-frequency signalling equipment will be carried out between Wolverhampton and Worcester GSCs, starting in the late summer of 1968 and continuing during the autumn and winter. These trials will include routing through the Birmingham TSC.

After the trials have been completed, the first four TSCs—Birmingham, Leeds, Manchester and Reading—will be brought into operational use in April 1969. They will be followed by eleven other TSCs so that by the spring of 1970, 15 TSCs should be in operation and approximately 120 GSCs will be equipped to route calls over the network. By the end of 1972, 34 of the 37 TSCs should be in service and about 90 per cent of GSCs should be equipped for transit working. By 1975 the last GSC should be equipped for transit working and it will then be possible for any subscriber in Britain to dial any other subscriber, thus completing STD.

#### THE AUTHOR

**Mr. R. B. Leigh**, is a Chief Telecommunications Superintendent in the Network Planning Department concerned with Trunk Routing.



Engineers from Dollis Hill and LTR help to install the new exchange at Empress, near Earl's Court.

Designed and developed by Post Office engineers, a new kind of exchange which promises to revolutionise the telephone system is now being installed in London to handle public traffic. It is . . .

## *The world's first PCM exchange*

**B**EIEVED to be the first of its kind in the world, a revolutionary telephone exchange is being installed experimentally in West London and will soon be carrying public traffic.

It is the first Pulse Code Modulation tandem exchange, designed and developed by a small team of research engineers at Dollis Hill, to test the feasibility of switching telephone traffic in

pulse code modulated form. It is being installed in the building which houses the Empress (01-367) local exchange and will later handle live traffic between subscribers in the Acorn (01-992), Ealing (01-567) and Shepherd's Bush (01-743) exchange areas.

This exciting development is a major breakthrough in the use of Pulse Code Modulation

**OVER**



Staff Engineer Mr. W. Duerdorff, leader of the Dollis Hill team, examines a plug-in unit on an A rack of the new experimental exchange.

The introduction of the new PCM tandem exchange will make PCM technically and economically acceptable on shorter routes since it eliminates the need for conversion equipment at the tandem exchange. Most of the components required are already widely used, particularly in the computer field.

A PCM tandem exchange has other important advantages, too. It is expected to cost only about half as much as the present electro-mechanical exchange handling the same amount of traffic and occupies only about a tenth of the space. It will also be capable of handling data transmission.

The new experimental exchange—a “skeleton” of a very much larger PCM exchange which may eventually be installed in central London—was recently demonstrated to the press at Dollis Hill before it was moved to the Empress exchange building.

Mr. W. J. Bray, the Director of Research, said that the experimental exchange could be the precursor of still more important developments to come, although he thought a nationwide PCM network was some way off. But PCM switching centres could find considerable practical application even while the main local network switching continued to be in analogue form through conventional electro-mechanical and electronic exchanges.

PCM transmission enables 24 simultaneous conversations to be carried on two pairs of wires that normally carry only two conversations. In normal telephony, the human voice is converted into complex electrical speech waves which travel down the wires to the receiver at the other end. These speech signals are strong or weak according to whether the speech is loud or soft. As they travel they are subject to various kinds of disturbances.

With PCM, the speech signals are broken down into a system of numbering based on the volume of sound. A strong signal, for example, might be represented by the figure 50; a weak one by the figure 5.

These numbers, transmitted in the form of high-speed digits, are sent down the wires and reconverted at the receiving end by a coding machine

(PCM). If the trials with the new tandem exchange are successful the way will be open for much greater use of the 24-channel PCM transmission systems which are now being installed in outer London and will soon be extended throughout the country. Clearly, this could lead more rapidly than has hitherto been thought possible to a fully-integrated, nationwide PCM network.

Until now, PCM has been used on junction routes linking different exchanges through which it has been impossible to pass calls in their PCM digital form. Instead, the calls have had to be converted into conventional analogue form before they can be switched and then changed back again into their digital form when they leave. The equipment needed to carry out these changes is expensive and for this reason PCM is uneconomic on routes of less than about ten miles.

Technical Officer Mr. A. Hartburn, checks a waveform of the new exchange during its installation at the Empress Exchange in London.

which builds them up again into the original voice pattern. This system is substantially immune from line disturbances. Since only tiny parts of each conversation are sampled, the junction cables connecting exchanges can carry up to 24 conversations at any one time by allocating each conversation its own "slot" in the time interval between samples. This technique is known as time-division multiplex.

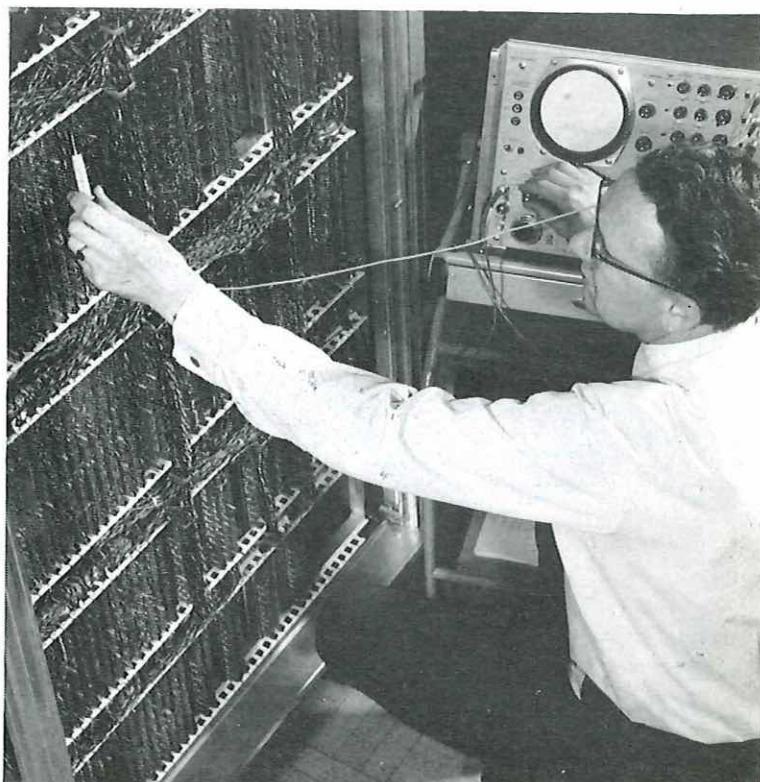
But then comes a big snag—the problem of converting and re-converting the signals at the exchanges.

The new switching system provides the answer by switching the PCM signals from one group of lines to another in digital form. The switching network is made up of three arrays of crosspoints—called the A, B and C switches. Any input to an A switch can be connected by way of any B switch to any outlet from a C switch. With this simple trunking arrangement, a particular channel time-slot from any incoming PCM transmission system can be steered by pulse trains through the appropriate crosspoint gates to the same channel time-slot in any outgoing PCM system. Because the cross-points are "time shared" in the same way as the PCM lines, very many more calls can be handled by the switches than by conventional contacts.

In practice, about 40 per cent of calls for a particular route can be switched without changing the time-slot. The PCM signals of the other 60 per cent of calls are delayed so that they fall into a different time-slot on the outgoing route. This time-switching enables the 24 time channels to be inter-connected and any incoming junction to be connected to any free outgoing junction to the distant exchange.

In switching by these means, the PCM signals at a crosspoint gate have to be completely in step with the pulse train operating the gate. For this reason "buffer storage" is required at the input to the tandem exchange. If the buffer stores are large enough, the PCM systems can operate quite independently from free-running oscillators.

A fundamental problem in developing integrated PCM switching and transmission is to determine the degree to which the demand for costly buffer stores can be reduced by operating

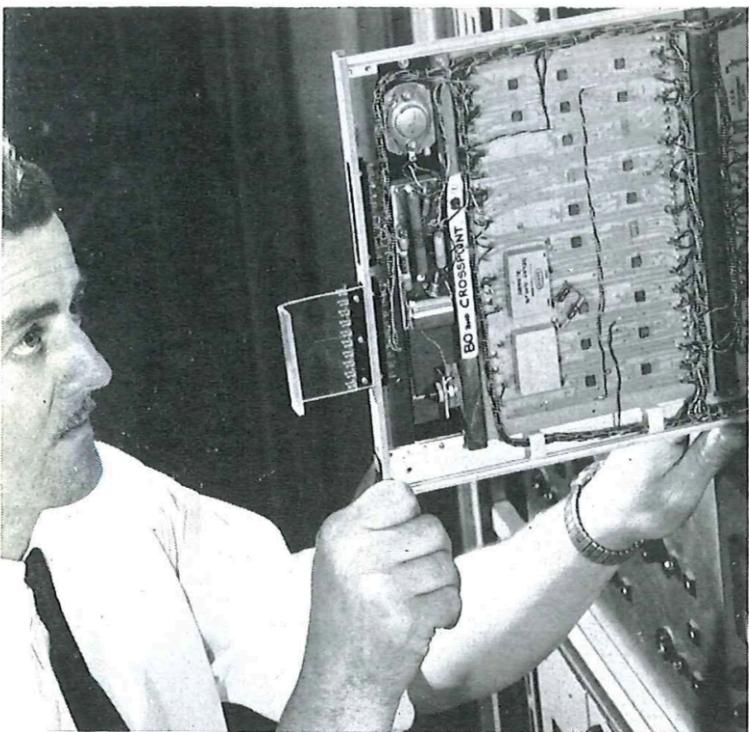


networks of transmission synchronously and in step with the exchanges. In a single PCM tandem exchange all PCM systems can be synchronised with the exchange by a common master oscillator which controls the distant PCM equipments—an arrangement known as the synchronous star network.

The time taken by the signals to travel from tandem to PCM and back again varies according to the temperature of the cable. These variations are compensated by a small buffer store into which the line signals are written and then read and reset at a time determined by the exchange clock-pulse generator. The alignment of the line signals with the exchange pulses is carried out in the "system unit" which also contains all the other equipment needed for a particular PCM line.

The circuits in the PCM system are separated into incoming and outgoing junctions by electronic gates, the former being steered to an incoming trunk unit and the latter to an outgoing trunk unit. For the Empress experiment, the odd circuits have been chosen for one traffic direction and the even ones for the other direction. Each trunk unit can then be shared between a pair of

OVER



Technical Officer Mr. D. Weedon inserts a switch unit into the new PCM system at Empress.

"system units" by taking the odd circuits from one and the even circuits from the other.

The incoming trunk unit detects new calls and clearances and during a call it stores a "hold" condition which is passed forward through the switches to maintain the connections.

If the exchange is unable to set up, the call is dropped back to additional stores in order to release register and traffic channels within the exchange and to return the PCM coded signals equivalent to the number unobtainable or busy tone, whichever is appropriate. When the channels are not in the "hold" condition, a signal is returned to the originating exchange to indicate that the junction is free and can accept the call.

Each group of incoming trunk units has access to a set of time-division multiplex register equipments by way of the R-switch. When a new call is detected, the connection store of a free register is written with the code of the incoming trunk unit in the calling channel time-slot. This makes a connection to a free time-slot in a register equipment and returns a pulse train to split the transmission path while the register is connected.

The register monitors incoming signals to detect Strowger impulses and the inter-train

pause. In addition, mis-operations are dropped back to the incoming trunk unit and the number unobtainable tone is connected. Strowger impulses are timed and counted to give the code of the wanted outgoing route.

For the Empress experiment, a single Strowger routing digit will be used and when the inter-train pause is detected the code of the routing digit is translated to apply a continuous marking signal to all PCM systems in the wanted route. From the marked system units, the free outgoing junctions are marked through C switches and at the same time the calling junction is marked by returning the calling channel via the R and A switches. Setting up is thus initiated by marking an A switch with the unique calling channel on a unique calling trunk and marking the C switches giving access to the wanted route with the free channels available.

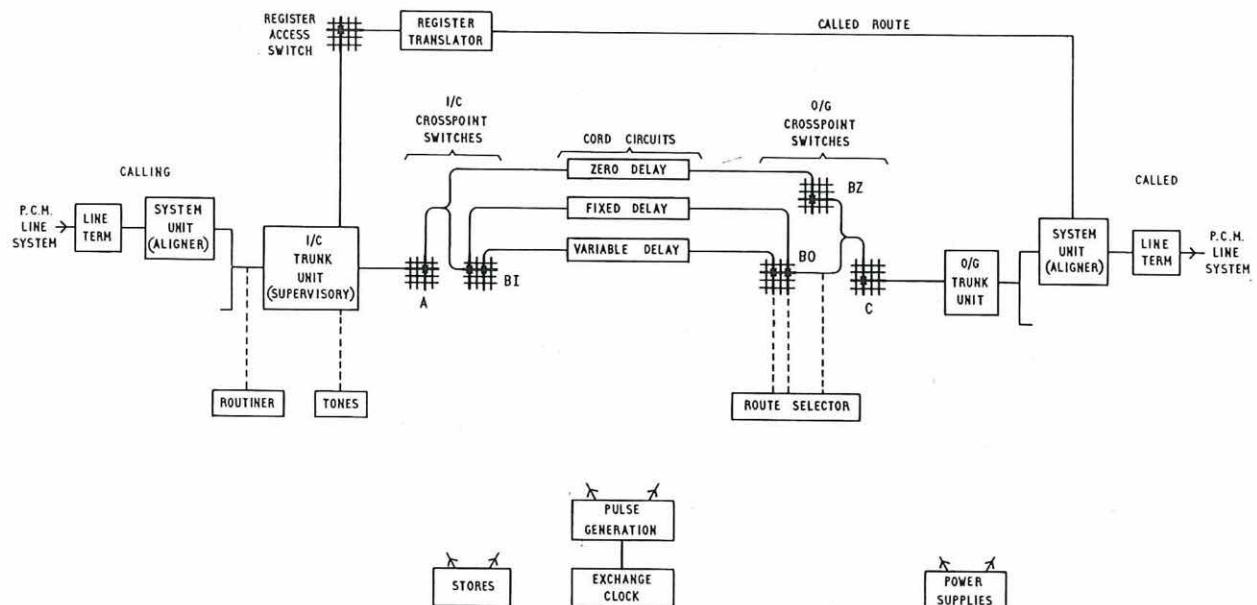
The marking signals applied via the A and C switches are allowed to pass over all A-B and B-C links in which the channels are free. In this way each B switch to which the A-B link is free at the calling channel time-slot receives an incoming mark. All the B switches also receive a number of marks on the outgoing side to indicate the B-C links and channels suitable for completing the connection. A set-up is possible only if the calling channel is free in the A-B link and a free outgoing junction is accessible by way of a B-C link.

A preferred and suitable path through the exchange is selected by electronic logic elements operating at the PCM digit rate of about 1.6 megacycles a second. The use of high-speed data and high-speed techniques developed for PCM transmission enable the control equipment to be greatly simplified. All paths can be examined in less than one-thousandth of a second.

The B switches are divided into a path giving zero delay and a delay path with incoming and outgoing switches. The switches provide access to cords which either delay all channels by a fixed number of time-slots or delay each channel independently by the appropriate number of slots. For economy, preference in the order of use is given to zero, followed by fixed delay and then by variable delay.

Path selection is thus split into three phases. In the first phase the calling channel passing through the free B switches is compared directly with the free outgoing channels marked via the C switches. All B switches able to accept the call return a

THE EXPERIMENTAL P.C.M. TANDEM EXCHANGE



This diagram of the experimental tandem exchange shows how the new system will operate.

signal to the B switch selector which chooses which B switch should complete the connection.

If all paths through the B switches are blocked, the fixed delay cords are examined during the second phase when the calling marking pulses are injected into those fixed delay cords in which the channel is free. All fixed delay cords in any one B switch introduce different delays so that the calling mark appears sequentially from each cord in turn and a simple comparison can be made with the free outgoing channels. Each B switch able to accept the call pre-selects the appropriate cord and returns a signal to the B switch selector. A quasi-random selection is then made of the B switch.

If no other path can be found, calls are offered to the variable delay cords. In this third phase, the B switches which have free access to a free outgoing junction and have both the links and the variable cord free at the appropriate channel times return the set-up possible signal. One of the B switches, selected as before in a quasi-random manner, determines the delay required and sets up its variable delay cord to produce that delay for the calling input channel.

The selected B switch sets up the call on its pre-selected path—zero, fixed or variable cord—by passing signals outwards over the transmission path. These signals write the code of the marked

links and trunks in the crosspoint operating stores which are later held over the highways by control signals from the register and then the incoming trunk unit.

Writing the crosspoint control stores establishes a connection through the exchange. The register then carries out a high-speed test to confirm the continuity of the crosspoints before the common marker paths are released. The register also performs a second and slower test to confirm that the relay set at the distant end is seized. The register then releases itself, thus removing the split on the transmission paths and handing over the holding function to the incoming trunk unit. This hold is maintained until clearance from both directions is detected.

Selecting and setting up a call through the electronic switches takes only 3.5-thousandths of a second. Confirming the seizure of the equipment at the far end of the junction may take considerably longer but sufficient time remains for the register to make one or more repeat attempts in a period of about 350-thousandths of a second—that is, about half the inter-train pause from a director pulsing out.

Failures during set up cause teleprinter equipment to print out details of the selected path and calls that cannot be completed are dropped back to number unobtainable or plant busy tone.

Something had to be done to protect the TAT cables from damage by fishing fleets. It called for burying 100 miles of cable by . . .

## TILLING THE OCEAN FLOOR

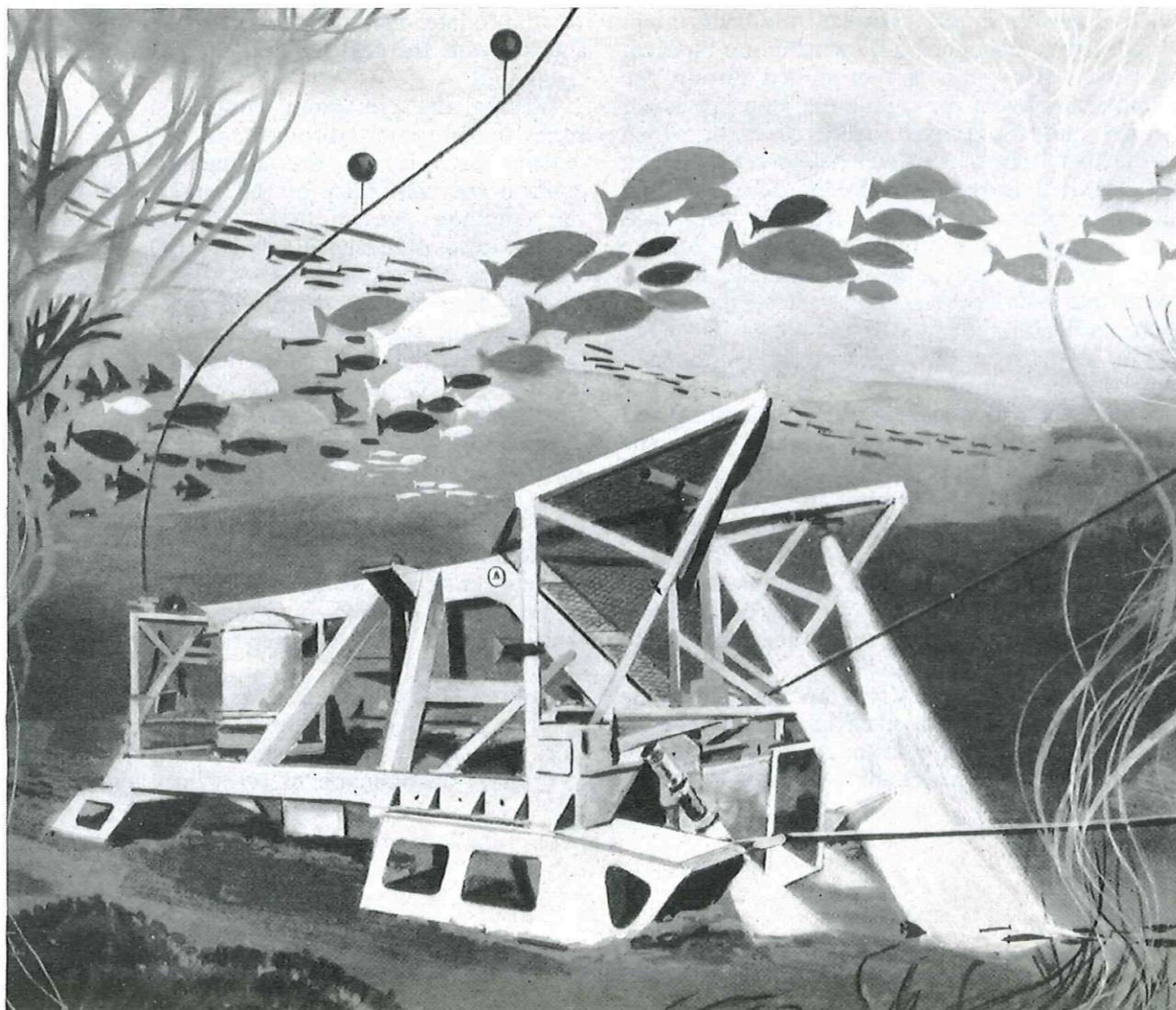
**L**OOKING like some prehistoric sea monster, a giant plough crawled along the ocean floor 100 fathoms down off the coast of New Jersey in the United States.

Remotely controlled from the surface by the Canadian Coastguard icebreaker-cable ship the *John Cabot*, the huge seaplough inched its way forward with the aid of three television camera eyes, leaving behind a section of submarine cable which it buried as it went along. Operation Seaplough—the first operation of its kind—was under way.

The story began in 1966 when a rich bed of scallops was discovered off the New Jersey coast in the area where the TAT-3 and TAT-4 trans-Atlantic submarine cables lie at their western ends. Before then, in spite of regular air and sea patrols warning skippers of the presence of the cables, fishing trawlers were a constant source of damage. In 1965 and 1966 alone the TAT-3 and TAT-4 cables were damaged and temporarily put out of action on four occasions by trawlers fishing on the seabed.

Now the danger was even greater as more and

An artist's conception of the seaplough working its way along the seabed, burying new cable as it goes.



As the plough is lowered into the sea, two divers adjust the tow sling attaching it to the *John Cabot*.

more fishing vessels converged off New Jersey in search of rich hauls of scallops. Sometimes, up to 65 scallopers at a time work the area around the cables and the Russian deep sea fishing fleets have also increased.

Representatives of the administrations involved met in 1966 to consider how best the cables could be protected and agreed to carry out trials in which the cables would be buried in the seabed. The trials were highly successful and the go-ahead was given for Operation Seaplough to begin.

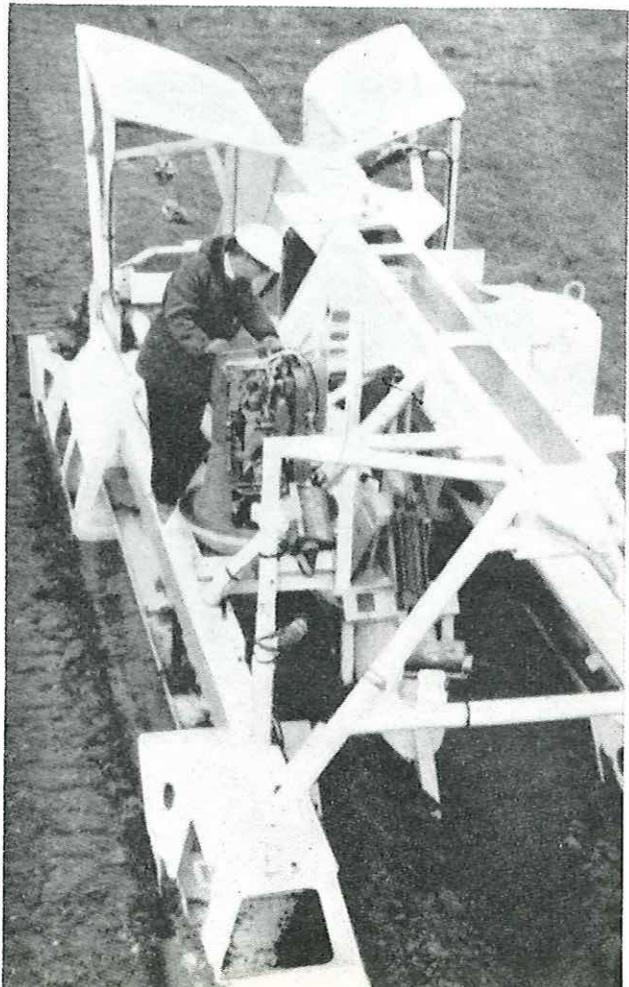
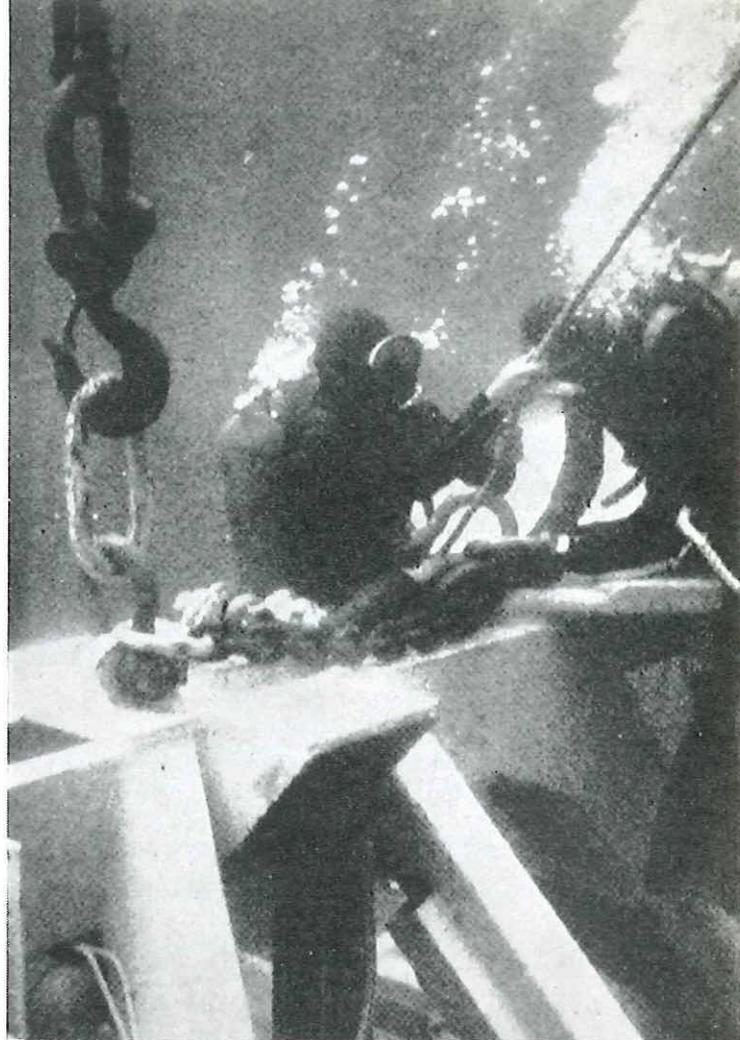
The tilling of the ocean was carried out by a special tractorlike piece of equipment developed by the Bell Telephone Laboratories and designed to dig down about two feet into compacted soil and bury cable and repeaters behind it.

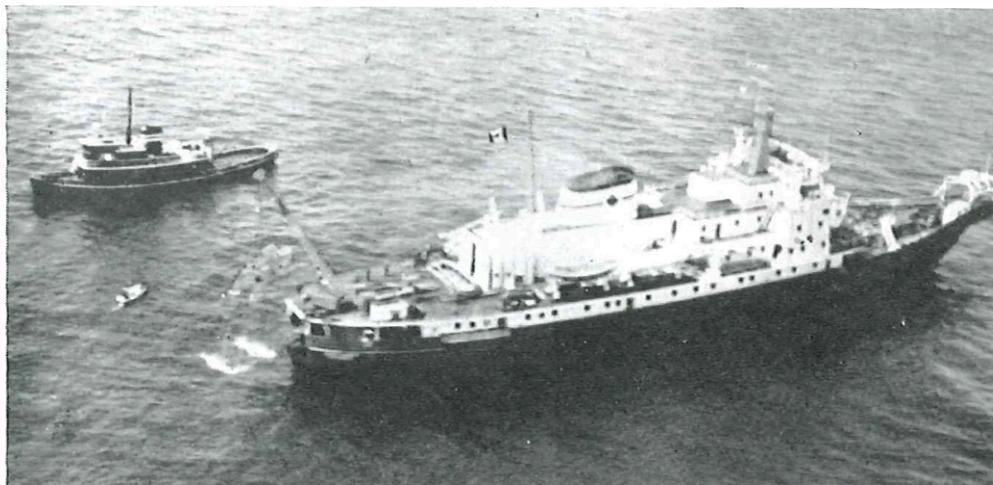
About 24 feet long, 11 feet wide and nine feet high and weighing about 14 tons, the seaplough can see, hear and carry out commands sent to it by remote control. In addition to its two television cameras, it carries a hydrophone and instruments to measure speed, distance travelled and collect other vital information. It is attached to its parent ship by a multi-core control cable and a steel towing cable which drags the seaplough along the ocean floor.

On Operation Seaplough the machine was launched over the side of the *John Cabot* and towed slowly along the cable route. As the plough moved forward on its four runners submarine cable was fed from the ship into the plough's bellmouth and feed tube and then into the trench that it dug. Auxiliary ploughing devices widened the trench by remote control when repeaters were laid.

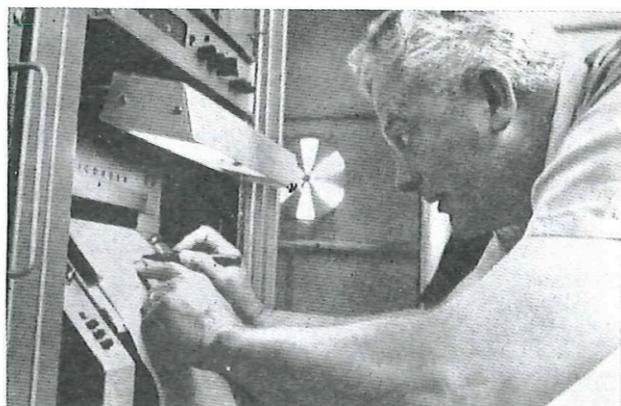
OVER

A rear view of the plough undergoing a trial run on land. Pulled by tractor, it did the job perfectly.



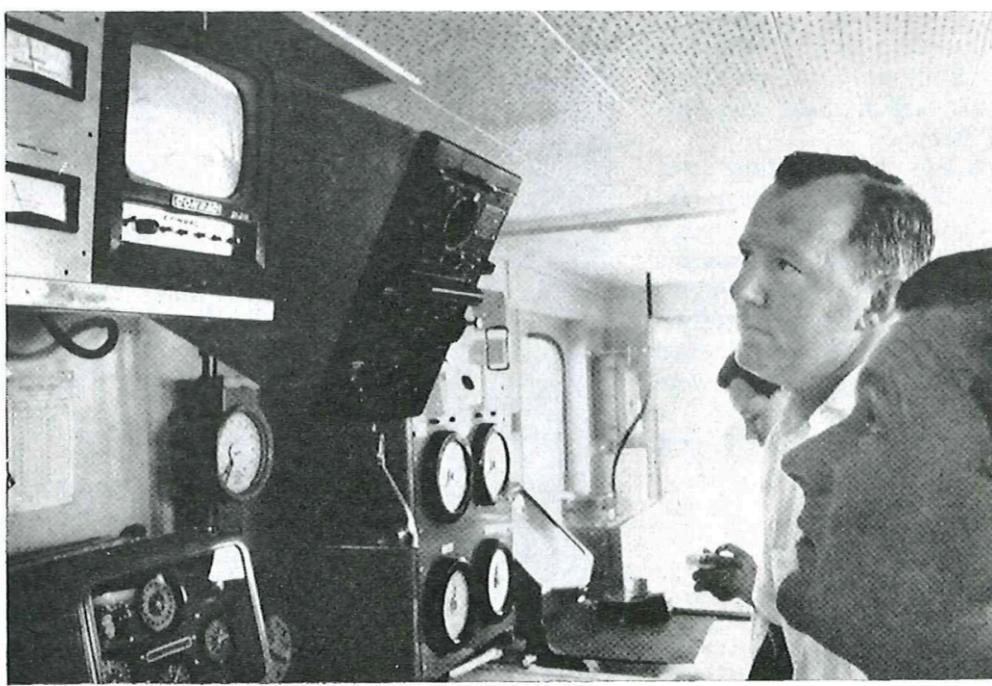


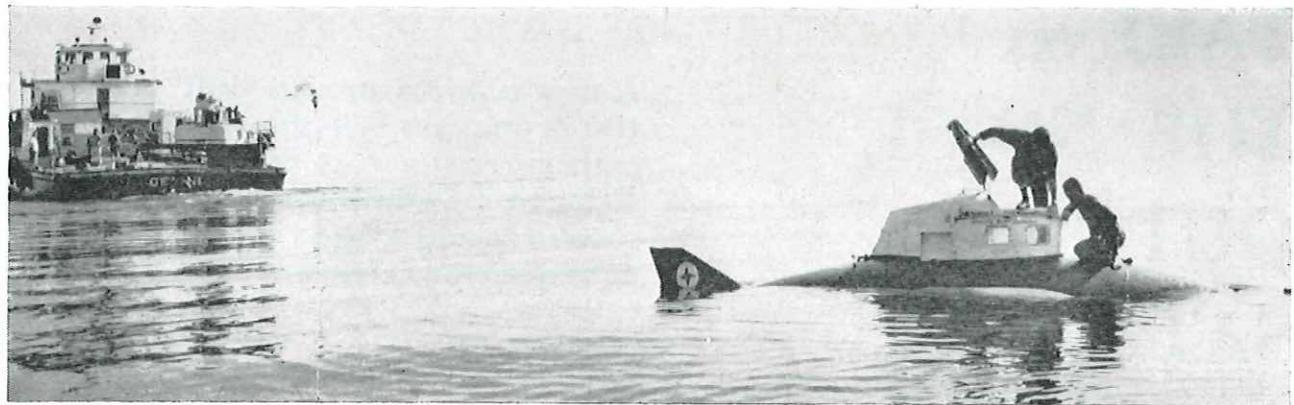
**Left:** The *John Cabot* steams slowly ahead, towing the seaplough behind it.



**Left:** An American Telephone and Telegraph Company supervisor checks the data being fed to the *John Cabot* as the seaplough inches forward.

**Below:** An AT and T manager and the *John Cabot*'s captain track the seaplough by television.





Part of the Operation Seaplough flotilla was this midget submarine which helped to pinpoint the cable route.

The *John Cabot* was accompanied on the operation by two tugs which served as headquarters for a crew of deep sea divers standing by to help out if needed and assisted in keeping the *John Cabot* on course during high winds; the Cable and Wireless Ltd's cable ship *Stanley Angwin*, which tested and connected the buried lengths of cable to the two TAT cables; and a United States midget submarine which pin-pointed the cable route and earlier carried out a survey to determine which portions of the two cables would have to be replaced and buried.

When the burying task was completed after nine days, the 97 nautical miles of new cable (55 nautical miles for TAT-3 and 42 for TAT-4) were joined to the original submarine cables by the *John Cabot* and the *Stanley Angwin* and the

replaced cable and repeaters were recovered by the British Post Office cable ship *HMTS Alert*. The new sections of cable and repeaters were laid in water varying in depth from 20 to 100 fathoms.

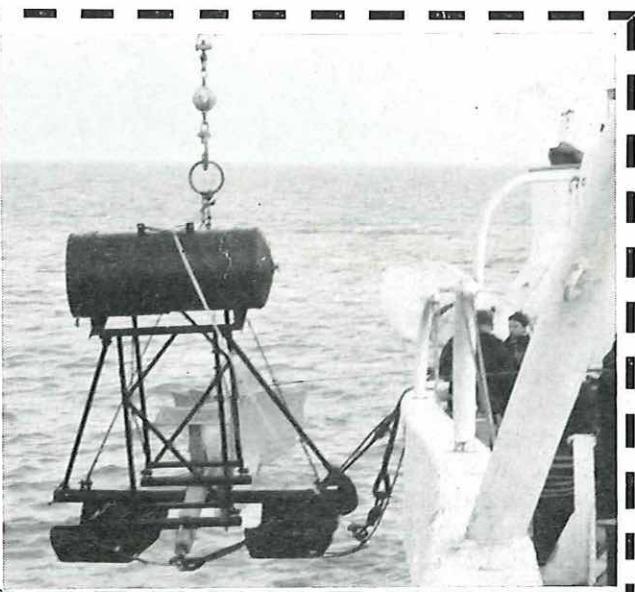
Not the least of the advantages of burying sea cable is that it increases the dependability of international communications. It will also mean considerable savings in patrolling and in repair costs since no further faults are expected in the buried sections in the foreseeable future.

Plans are now being made to use the seaplough for burying the Florida shore end portion of a new fully transistorised, 720 circuit cable which will be laid to link Florida and the Virgin Islands later this year, and the shore ends of the new 720-circuit trans-Atlantic TAT-5 cable to be laid in the spring of 1970.

## NORTH SEA EXPERIMENT

As the Journal went to press, Post Office submarine cable laying experts were assessing the results of a two-day trial recently carried out in the North Sea off Lowestoft with a sugar-cane plough adapted to burying undersea cable.

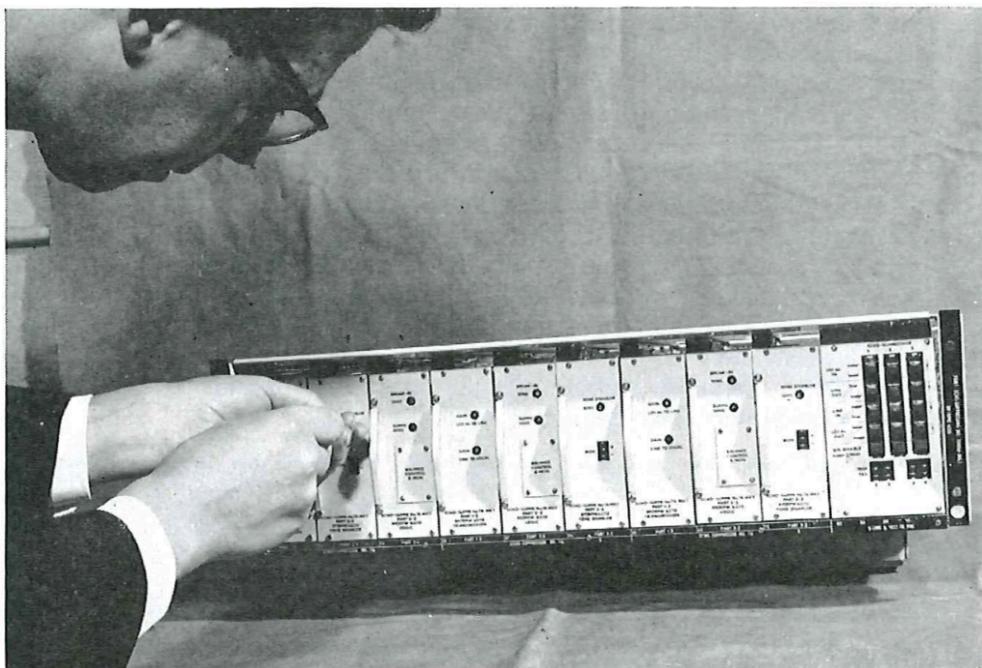
The plough (picture right)—fitted with skids and a buoyancy tank to keep it upright on the seabed—was operated from the Post Office cable ship *HMTS Alert*. As the plough was pulled along the seabed by *Alert*, its cutting blade bit into the sand and dug a furrow about 18 inches deep into which cable could be buried.



# TAKING THE NOISE OUT OF SATELLITE CALLS

A new suppressor will "kill" the echoes on telephone calls carried across the Atlantic by communication satellites and make conversations clearer

By A. G. HODSOLL



The author adjusts a tone disabler sensitivity control of an echo suppressor No. 7A mounted in an equipment echo suppressing 1000 A.

**A** NEW device designed and developed by the Post Office will considerably improve the quality of trans-Atlantic telephone calls made by way of synchronous satellites.

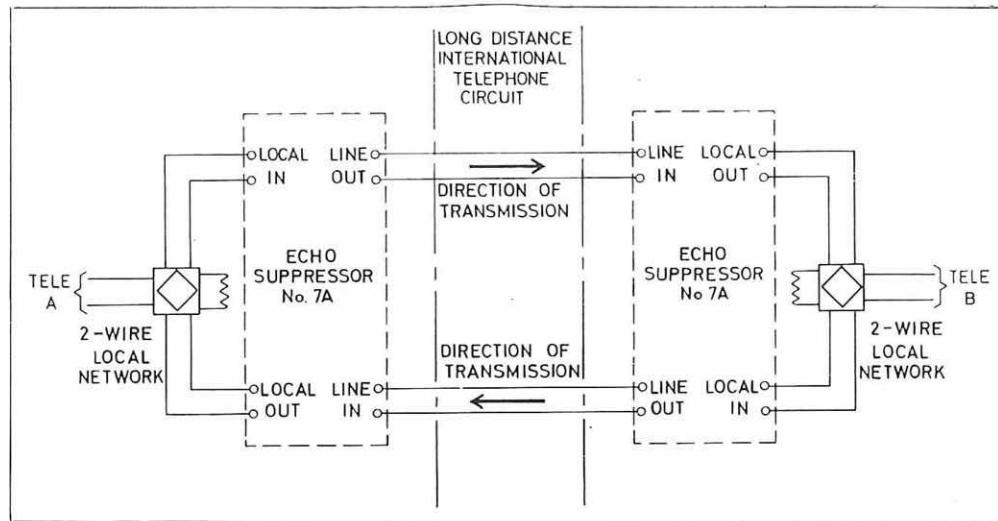
Called the Echo Suppressor No. 7A, it will virtually eliminate speech distortions caused by echoes on long-distance connections—a problem which has been worrying the British Post Office and overseas administrations since the first com-

munications satellite, *Telstar*, was launched six years ago.

The first 120 of the new style suppressors were recently installed at the International Switching Centre at Faraday Building, London, for use on trans-Atlantic telephone circuits routed by way of the *Intelsat I* (*Early Bird*) and *Intelsat III* satellites.

Echoes on long-distance telephone connections occur because speech signals are reflected from

This diagram shows how the echo suppressor is connected into the 4-wire audio portion of an international telephone connection. Under "no signal" conditions, the transmission paths of both echo suppressors introduce no loss or gain into the circuit.



the junction of the four-wire (long-distance) and the two-wire (local network) portions of the connection. Speech signals take a measurable time to travel and when, on longer-distance links, the interval between the time a person speaks and the time the echo of his voice reaches him amounts to more than 40 milliseconds, the echo becomes objectionable and an echo suppressor is needed to remove the resultant disturbance.

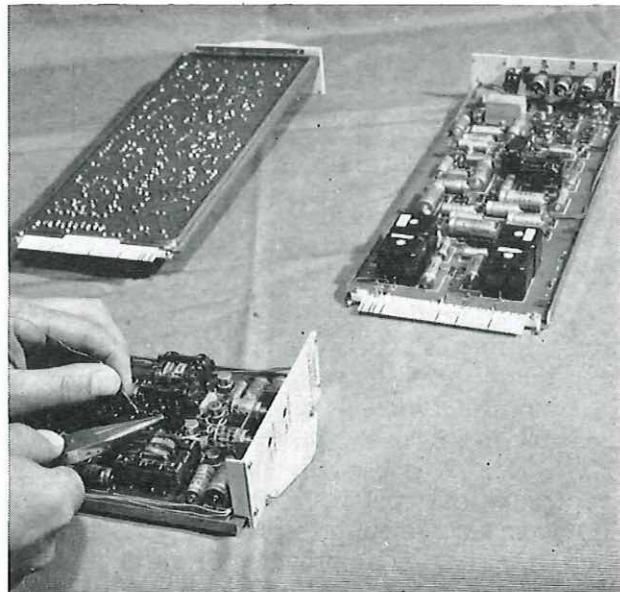
Echo suppressors were necessary on inland telephone circuits in Britain when the long distance trunk network consisted mainly of loaded audio cables in which speech signals took a long time to travel through the cable.

With the introduction in the early 1950s of carrier, coaxial and microwave systems, in which the speech signals travel much faster, echo suppressors were no longer needed in the national telephone system but they were brought into use again in 1958 on international submarine cable circuits, for example, the trans-Atlantic telephone cables. These older designs of echo suppressor could provide the answer for dealing with echo delays of up to 100 milliseconds.

The arrival of communication satellites hovering 22,500 miles in space produced a much bigger problem since the echo delay time on telephone calls made by way of such a satellite approaches 600 milliseconds. A much better echo suppressor was needed as quickly as possible.

After many months of investigation and experiment a number of prototypes were produced and tested and now the No. 7A has been perfected to carry out its important task.

Basically, an echo suppressor is a voice operated

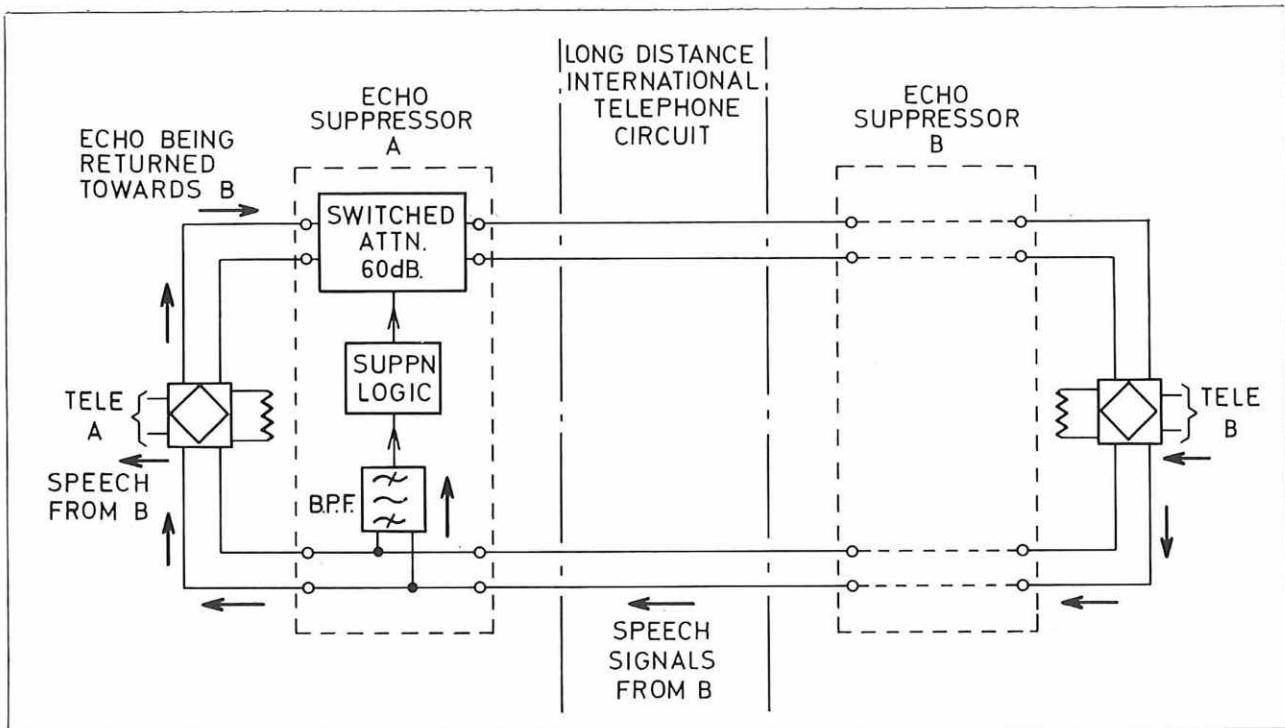


Connecting wire strips to an attenuator on the transmission card of one of the new echo suppressors. Behind, are the tone disabler card (left) and the logic card.

device using a small part of the speech signals in one direction of transmission to operate an electronic logic circuit which switches a high value of attenuation into the other direction of transmission. This high value of attenuation suppresses the echoes which would otherwise have been returned to the talker's ear.

Further logic circuitry is necessary to permit the listener to interrupt the talker or to make interjections so that the talker knows that the listener

**OVER**



When B speaks to A, the echoes of his speech are suppressed by the 60 dB attenuation, switched into the return transmission path by the suppressor at A's end of the circuit. A small part of the speech signals from B pass via the bandpass filter (BPF) to be detected by the logic circuit which operates the 60 dB switch. Similarly, the suppressor at B's end prevents echoes being returned to A when he speaks

is still hearing his speech. This "break-in" logic must distinguish between echoes and speech from the former listener and, if it detects speech, the suppression must be quickly removed to allow the break-in speech to be transmitted to the talker.

The No. 7A is basically similar to other echo suppressors but contains a number of significant improvements. It suppresses echoes much more effectively, has an improved "break-in" facility and incorporates a tone disabler which prevents echo suppressor action during the transmission of data signals.

The improvement in echo suppression has been achieved by increasing the bandwidth accepted by the speech detectors and the amount of suppression loss from 40 decibels to 60 decibels. Echo suppression has also been improved by the fast operate time of the 7A—about one millisecond.

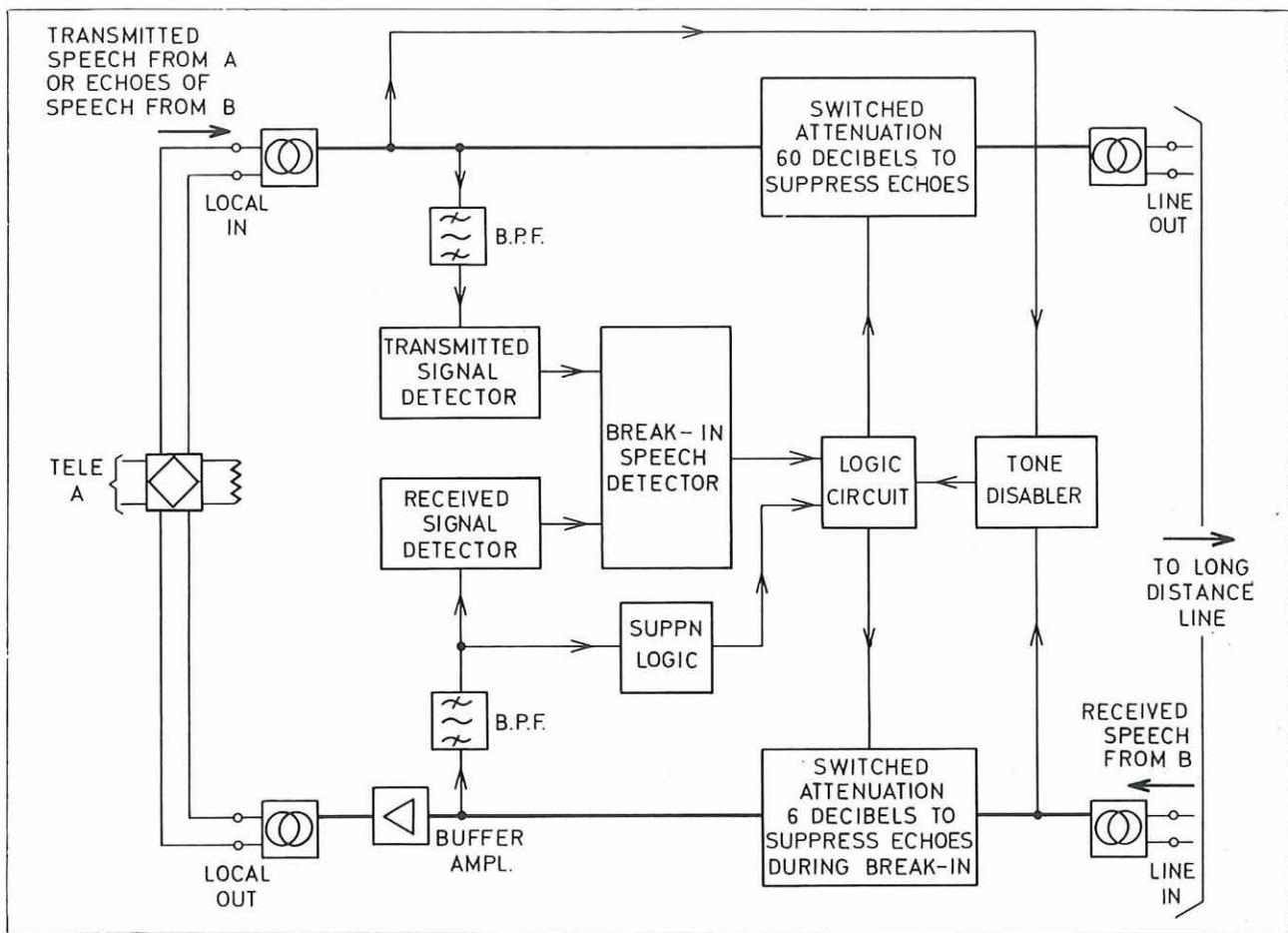
The new "break-in" facility enables the listener to interrupt the talker and for his interjections to be clearly heard without echo distortion. It also gives better echo suppression and less mutilation of speech when both participants speak simultaneously.

The tone disabler is brought into use when a telephone circuit is needed for transmitting data signals simultaneously in both directions. It is conditioned by a single frequency tone within the 2,000 to 2,500 Hz bandwidth which is sent in advance of the data stream. The conditioning tone must persist for 300 milliseconds before the tone disabler will operate.

When it operates, in addition to inhibiting the echo suppressor, the tone disabler changes its own circuit so that it can be held operated by data signals until there is a break in the data transmission of more than 100 milliseconds. The long conditioning time, together with a circuit which accepts energy from speech signals at frequencies outside the conditioning band and which uses them to oppose operation of the tone disabler, prevents false operation by speech signals.

The Echo Suppressor No. 7A is superior to any of its predecessors in terms of operating speed, frequency response, noise and input and output impedance, and is easier to set up.

It is fully transistorised (the circuit contains 65 transistors) and is laid out on three printed wiring boards which give greater reliability. Forty-two of



A simplified block schematic diagram of the echo-suppressor at A's end. When B speaks, the suppression logic passes a signal through the logic circuit to operate the 60 dB suppression. The break-in speech detector continuously compares speech signals in two directions of transmission. When it detects break-in speech from A it passes a signal to the logic circuit which removes the 60 dB suppression, thus permitting A's speech to be transmitted to B. Under break-in conditions, the logic circuit also switches an attenuation of 6 dB into the receive transmission path. Because the suppressor at B has switched to the same state, there is a total attenuation of 12 dB switched into the echo paths which partially suppresses echoes when both A and B speak at the same time. A conditioning tone sent in advance of data signals is detected by the tone disabler which sends a signal to the logic circuit to disable operation of both the 60 dB and the 6 dB switches.

the new echo suppressors can be accommodated in each 62-type rack in the same space occupied by 14 of the older type.

The prototypes were tested in the Line and Radio Systems Branch laboratory at Crucifix Lane, S.E.1, followed by subjective testing at Dollis Hill which proved that the new echo suppressor is compatible with and at least as efficient in performance as similar echo suppressors developed by overseas administrations.

\*The Echo Suppressor No. 7A was designed and

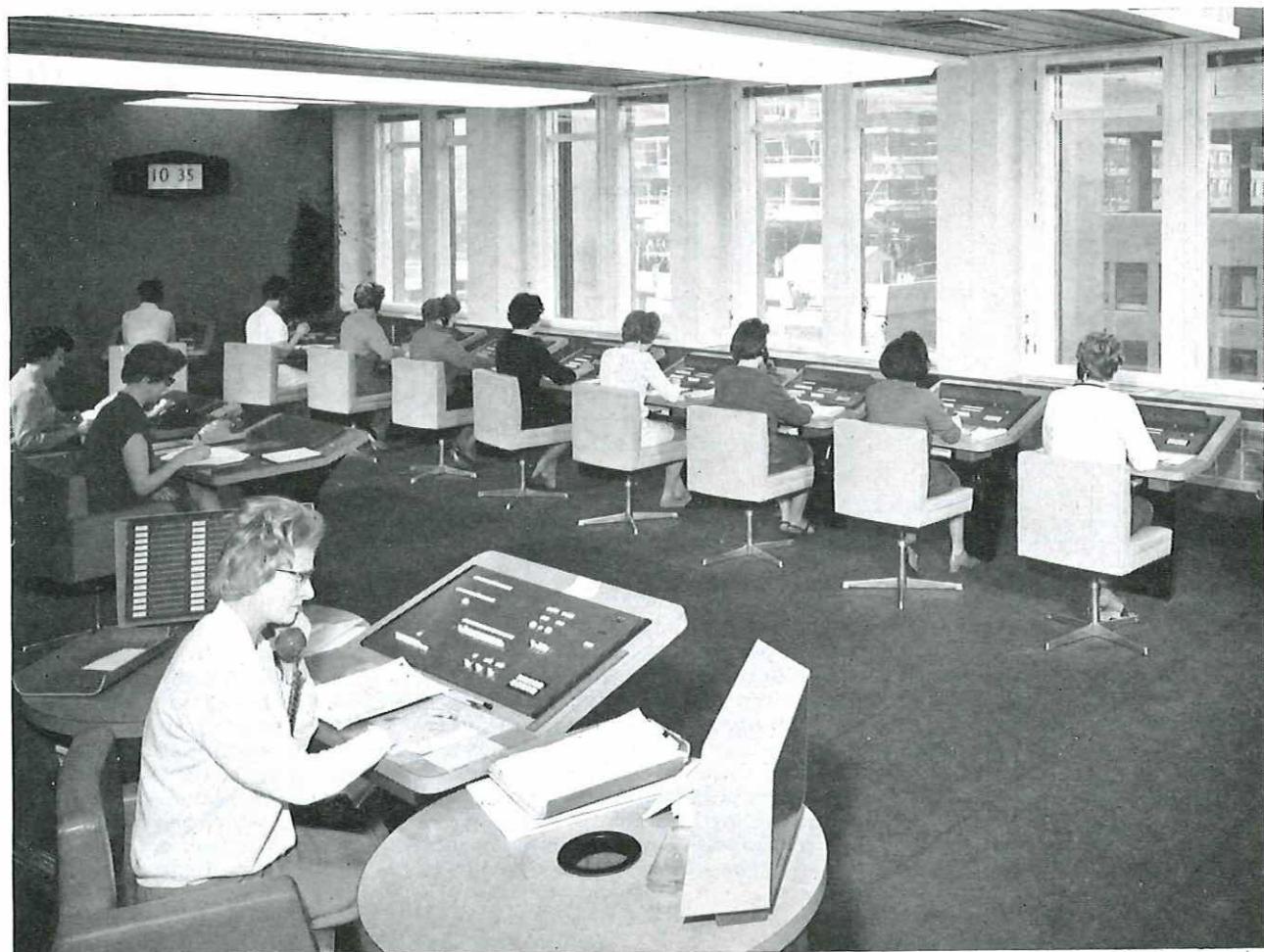
developed by the Line and Radio Systems Branch of the Post Office Telecommunications Development Department in conjunction with Associated Electrical Industries Ltd.

#### THE AUTHOR

Mr. A. G. Hodsoll joined the Post Office in 1947 as a Youth-in-training at Hastings in the Tunbridge Wells Telephone Area. On promotion to Assistant Executive Engineer in 1961 he joined LMD Branch of the Engineering Department where he has since worked on the design and development of audio transmission equipment. He was a member of the team which began to develop the new echo suppressor in 1965.

**Britain's first electronic private telephone system has just been brought into service in London. It has 5,500 lines and is . . . .**

## **BRITAIN'S MOST ADVANCED PABX**



**A view of the telephone operators' room at British Petroleum's new private exchange system in Moorfields.**

**B**Y pressing four buttons on an extension telephone, an executive in the British Petroleum Headquarters in London can communicate in a matter of seconds with the Company's office in Paris, without assistance from telephone exchange operators.

This is only one of the many unusual and advanced features incorporated in Britain's first electronic private telephone system which has

just been brought into full operation at the 35-storey BP building in Moorfields, London.

Basically, the new system is a 5,500 line private automatic branch exchange (PABX)—as large as telephone exchanges in some British cities—together with 6,000 telephones, all provided with press-button keys in place of dials. It has facilities for incoming calls to be dialled direct to an extension, a separate internal telephone network and



One of the nine operators' console positions.

50 private wires to branches throughout the country.

A unique feature is the magnetic drum equipment—a memory device which stores information in binary-digit form on a specially prepared surface of a metal cylinder. This information can be read from the drum by magnetic heads.

Up to 3,000 of BP's most frequently-required business telephone numbers—up to 17 digits—can be "stored" on the drum and each of these numbers is allocated a particular four-digit code. An extension user wanting one of the stored numbers simply keys the appropriate code by pressing the telephone digit buttons. The equipment recognises the codes and causes the digit train of the stored number to be pulsed-out automatically, routing the user to the required destination.

Many of the internal telephones are linked to one of a number of dictating machines. There are four extra buttons on the top of the telephones which give stop/start and playback facilities and call the typing pool supervisor. Letters dictated

into the machine are recorded on discs ready for collection by a typist.

Some of the telephones are not required for outside calls while others are needed for London calls only and not STD calls. If unauthorised calls are made on these telephones the magnetic drum can be programmed to reject the call, the caller receiving the number unobtainable tone.

The exchange has nine operator positions and three enquiry positions, two assistant supervisors' tables and one supervisor's position. Lamp display units indicate busy lines and the number of calls which are waiting. There are also special facilities to indicate executive calls.

On each operator's position there are handbag racks and the operators' chairs are of the latest design, adjustable in height and covered in coloured hide.

BP is the first firm in the country to have an electronically-controlled PABX and only the second to have direct dialling of incoming calls to extensions.

The new system was manufactured by the Plessey Telecommunications Group, Liverpool.



# THE HEART THAT MAKES THE TOWER TICK

By K. E. WARD

**Worm's eye-view of the Post Office Tower rising above the building which houses two trunk exchanges, a tandem exchange and a TV switching centre, together occupying  $2\frac{1}{2}$  acres of floor space.**

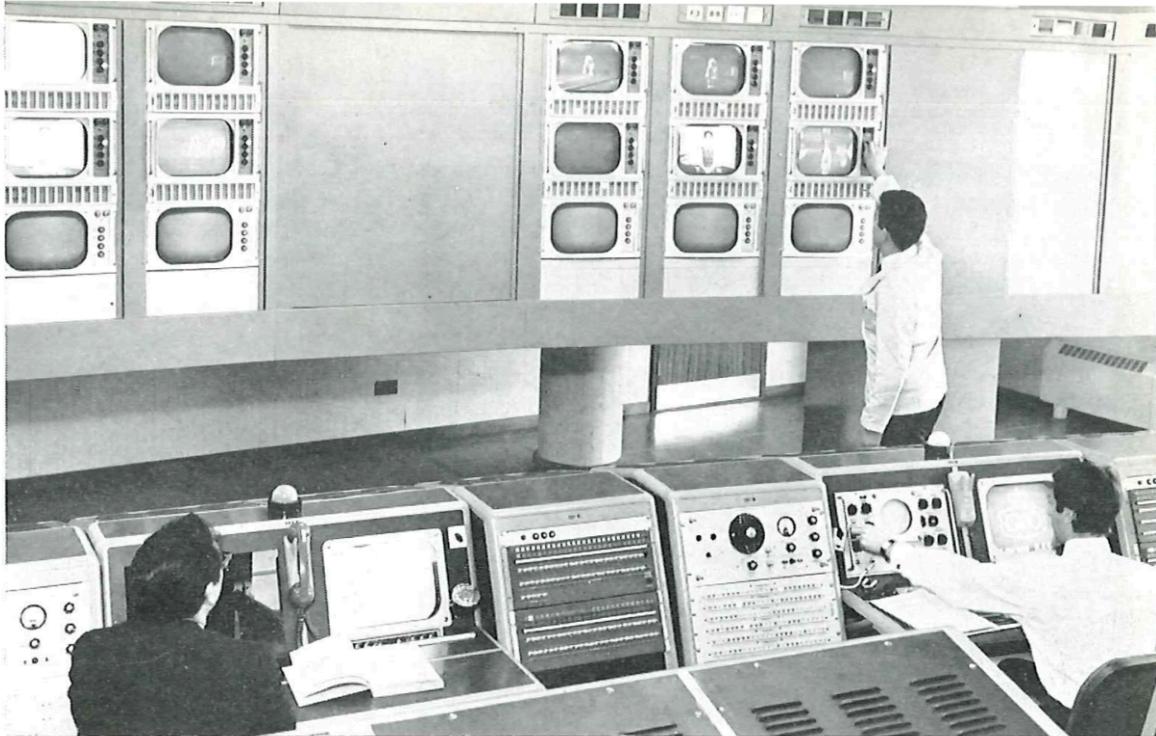
**T**HE Post Office Tower, symbol of 20th century technological progress, has received a great deal of publicity as the hub of Britain's expanding microwave communications network. But little has been said of the large building at its base which contains the heart of the complex and without which the Tower would be incomplete.

Apart from being the largest single building project ever undertaken by the Post Office, it contains a unique and comprehensive collection of modern communications equipment installed on some two

miles of racks. Future plans include the installation of Pulse Code Modulation transmission systems and multi-frequency signalling equipment.

During its planning and design some interesting and unusual problems, such as the power arrangements and ventilation, had to be overcome, providing valuable experience for the large multi-unit buildings planned for the future.

The accommodation, which comprises some two-and-a-half acres of floor space, houses two major trunk exchanges—Mercury and Tower—the Museum tandem exchange and the London



Inside the London Television switching centre control room. About 5,000 switchings are made each month.

Television Switching Centre, together with the supporting repeater, power and ventilation equipment.

Mercury switches traffic into London and Tower switches traffic out of London. Museum tandem exchange routes traffic between London director exchanges.

Welfare arrangements include a large staff dining-room and lounge and, to cater for visitors as distinct from sightseers to the Tower, there is a 36-seat cinema and reception lounge.

The building is served from two main distribution frames. Junction cables are terminated on a 200 vertical MDF while trunk cables appear on another consisting of 100 verticals. Much of the frame wiring uses the new solderless wire wrapping technique.

Mercury trunk exchange, which switches trunk traffic into the London Director Area, has a capacity for 7,000 incoming trunk terminations. The trunk circuits terminate on signalling relay sets which convert the line signals into direct current pulses required to route the call through the exchange and to provide the necessary supervisory conditions.

Associated with each signalling relay set is a first selector and a register access relay set with a register hunter to provide access to the common register translators.

Switching is carried out on 4,000-type two-motion selectors, a considerable saving in junction

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Technical Officer D. Hooker checks a unit in an electronic common equipment cabinet in Mercury exchange. Each cabinet pair has an ultimate capacity for handling 194 simultaneous calls.





These are the two main distribution frames which serve the building. They extend to 300 verticals and are among the biggest of their kind in Britain.

line plant being achieved by sharing most of the 11,000 outgoing junctions with the Museum Tandem Exchange, although 35 of the larger Director Exchanges have exclusive routes from second selector levels.

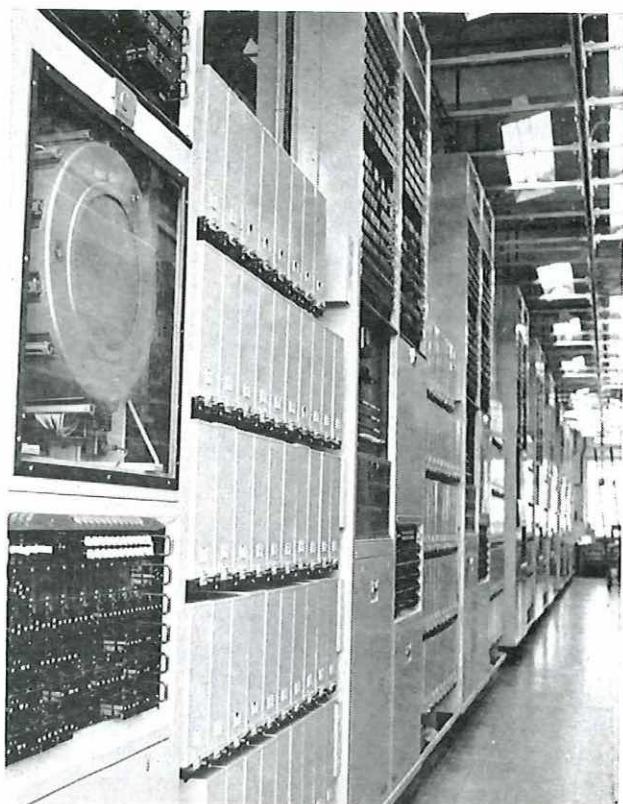
The outstanding feature of the exchange is the electronic register translators, comprising eight pairs of cabinets to convert the three code digits identifying a London Exchange into anything up to eight digits required to route the call through the rest of the Exchange and Director network. Each cabinet pair has an ultimate capacity to handle 194 simultaneous calls on a time-sharing basis, each call being connected to the electronic processing equipment for 80 micro-seconds at recurring intervals of 16-2/3 milli-seconds.

Incoming dialled information is stored on ferrite cores and processed by transistor and core logic circuits.

The Tower Trunk Exchange was designed to switch STD calls originated in the London Director Area, although ultimately it will handle only traffic from the Centre Area, for which its capacity of 7,000 incoming terminations will cater until 1975.

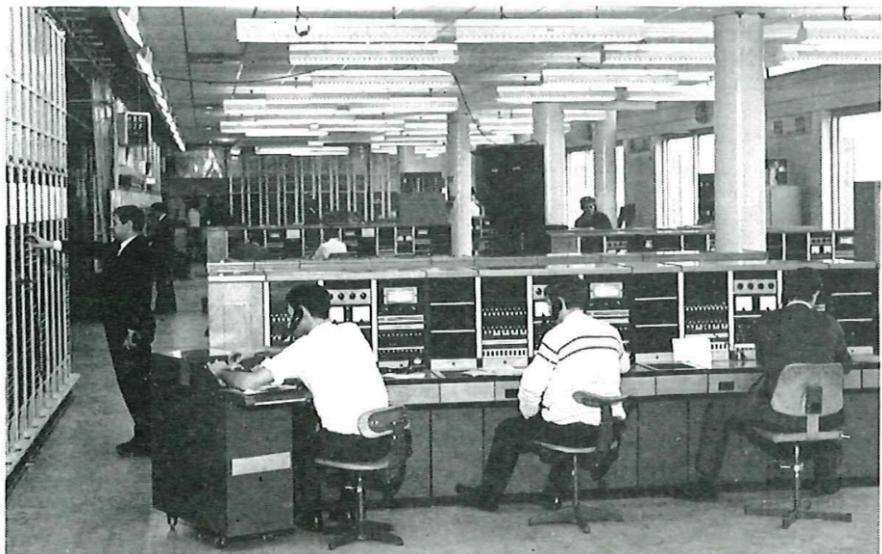
The incoming junctions terminate on register access relay sets which provide access to the register translators by way of register hunters and are also connected to the first selectors which are of the 4,000 two-motion type. However, motor uniselector group selectors are used for the final switching stages because their increased availability results in a worthwhile saving of trunk lines. Controlling register translators are provided to convert the national code into routing digits and to determinate the charge rate.

Ultimately, 24 electronic register translators will be installed and these will eventually be modified



A suite of register translators in the Tower Exchange. The RT in the foreground has had a panel removed to show the position of the magnetic drum which is located under the circular cover.

**The Test Room—focal point of the building—showing the suite of test jack frames and some of the test desks.**



to provide multi-frequency signalling facilities to enable the exchange to route calls over the proposed transit network. Each register translator uses a nine-inch nickel-plated magnetic drum rotating at 2,160 revolutions a minute and sub-divided into a number of magnetised tracks on which the received and translated digits are stored together with translations and charging information. The electronic common equipment uses valves and semi-conductor diodes, information being processed as 9.7 micro-second code pulses.

The third exchange in the building replaced the original Museum Tandem exchange in the adjoining Museum exchange building. Its function is to switch traffic between London Director exchanges. The equipment consists of 4,000 type two-motion selectors with auto-auto relay sets to provide holding and transmission facilities. A number of information final selectors provide access to recorded information services.

The large trunk repeater station on the ground floor contains a variety of equipment to amplify and convert the telephone conversations into a suitable frequency range for transmission over the line systems and microwave radio links connected to the building. In addition, groups of circuits are routed through the repeater station from other London trunk exchanges and repeater stations.

At present, equipment is provided or planned to route 56,000 circuits through the station,

although this is by no means the ultimate capacity.

To economise in equipment and provide flexibility of routing, the conversations pass through several stages of modulation before being translated to their final frequency range. Initially, they are assembled into groups of 12 occupying the frequency range 60-108 kHz after which 60-channel (five group) supergroups are formed with a further change of frequency to the range 312-512 kHz and finally a number of supergroups are assembled into a hypergroup to occupy the frequency range for the line or radio equipment.

Testing and commissioning the trunk and junction circuits is carried out in a large test room containing nine suites of test desks comprising 27 positions with comprehensive testing facilities. In addition, three positions house line-routiner remote control panels and cable gas pressurisation alarms with fault locating equipment. Test access to the trunk and junction circuits is obtained by way of a suite of 70 test jack frames with capacity for 33,700 circuits. Incoming junctions are tested from the Main Distribution Frame by way of patching circuits to the test jack frames. Outgoing circuits can also be bussed from the test room. Future plans include a Precision Test Centre in the test room for locating cable faults.

The London Television Network Switching Centre is on the third floor in special accommoda-

**OVER**

**Right (above): the standby diesel engine alternators in the power room. Below: The standby batteries which can supply power to the exchanges if the main's supply fails. They weigh 155 tons.**

tion with under-floor cabling, controlled lighting and sound insulation. There is also a visitors' viewing gallery. Facilities are provided for terminating and controlling sound and vision circuits, including colour, rented by the BBC, ITA and various programme companies. The circuits comprise main links to other network centres, links to transmitters and local circuits to various studios.

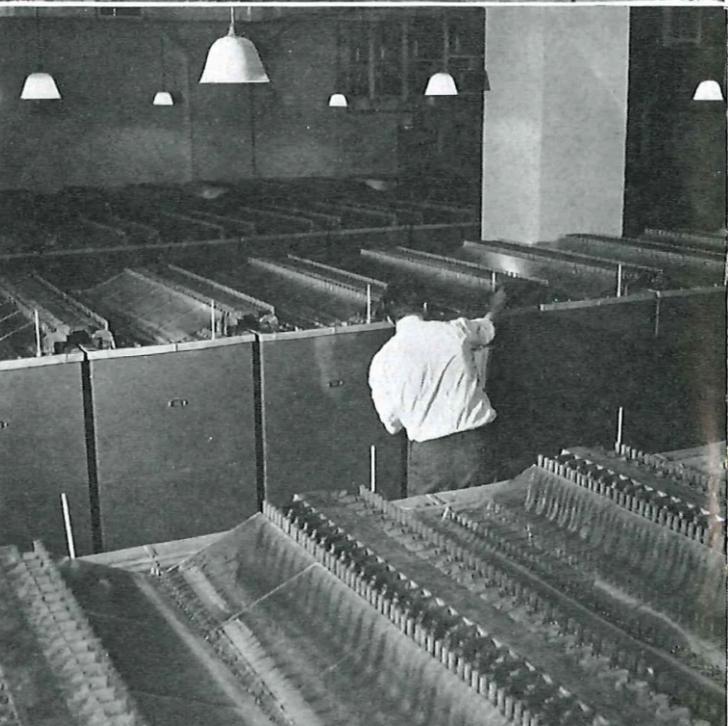
A permanent outside broadcast network terminates at the Outside Broadcast switching centre (also on the third floor) which is linked to the Network Switching Centre. The BBC have a permanent national network and carry out switching at their own premises but the ITA transmitters are shared by the commercial companies and the links are inter-connected at the Network Switching Centre.

Automatic switching of both vision and sound channels is carried out at the precise scheduled time synchronised with the Speaking Clock. About 5,000 switchings are made each month. Television links, both line and radio, are routed by way of the Television Repeater Station and terminate on video distribution racks which have a capacity for 1,800 channels. The circuits are connected direct or by way of the network switching console.

Testing and maintaining the circuits is carried out on five test consoles with two monitor suites containing 20 picture monitors (with provision for 54) to enable picture quality on any circuit to be checked.

To ensure that mains failure does not interrupt the vital telecommunications and television services there is a large and complex power plant supplying five million watts of AC power. It uses two separate alternative mains supplies, with short break changeover if the one in use fails, backed up by five 743-hp, six-cylinder diesel engine alternators capable of supplying 2.5 million watts of power in the event of complete mains failure. Fuel is supplied from three 16,000 gallon tanks.

Most of the transmission and exchange equipment requires DC supplies which are provided by separate power plants. The largest supplies up to 12,000 amps. at 50 volts to the exchange equipment and consists of six (with provision for seven) 2,000 amp. mechanically-regulated rectifiers and two



Off-duty staff  
snatch a welcome  
break in the  
lounge.



15,000 amp.-hour batteries weighing 155 tons. Distribution to each floor is by way of a riser consisting of a 20-bar aluminium busbar with a cross-section of 80 square inches and weighing five tons—the largest so far installed by the Post Office.

In marked contrast is the 1.08 square inch total cross-sectional area of the 18 mineral-insulated, copper-sheathed cables that supply the AC power to the plant. The plant is unique in that no fuses or circuit breakers are provided at the plant itself, fusing being carried out on the equipment floors. Floor load current is measured remotely, using transductors wound over the busbar feeds at each floor. These convert the magnetic field due to the current into an indication of its magnitude. A separate 30-volt plant supplies the electronic register translators in the Mercury exchange and the Repeater Station DC power is derived from the other plant.

There are also two large ventilation plants to cope with the considerable heat radiated from the equipment. Air is pumped into the equipment floors at the rate of 17,600 cubic feet a minute by way of electrostatic filters which are automatically taken out of service periodically and washed.

In addition, 37 free standing cooling units circ-

ulate air, which is cooled by a refrigeration process, to equipment which gives off excessive heat. The water for cooling is supplied from six cooling towers at the rate of 4,000 gallons an hour.

The Tower communications complex has been operational for two years and has already made a significant contribution towards meeting London's trunk traffic demands. The installation was carried out by several contractors and acceptance testing was done by the Centre and Long Distance Areas. Many difficulties were encountered, mainly because of limited access to the site and the need to phase the installation of equipment as the building was erected. But all have been overcome through the magnificent skill and co-operation of all involved in completing a tremendous and well worthwhile task.

#### THE AUTHOR

**Mr. K. E. Ward, C.Eng AMIREE** joined the Post Office in 1948 as a Youth-in-training in the Canterbury Area and was transferred to Long Distance Area in 1957 as an Assistant Executive Engineer, employed initially on Trunk Exchange maintenance duties and eventually as Clerk of Works at the Post Office Tower.

On promotion to Executive Engineer in 1965, he moved to the LTR Regional Headquarters and is now a member of the Long Term Planning Branch.

# GIRO'S BACKBONE IS A GIANT COM-

Eleven computers and 365 encoding machines will handle more than a million transactions at the Post Office's new Giro Centre in Bootle



A general view of the equipment now being installed at Bootle, being tested at the manufacturer's works.

WHEN the National Giro—the new current account banking service run by the Post Office—comes into operation this autumn its success will depend very largely on the highly complex computer system now being installed at the new Giro Centre at Bootle, in Lancashire.

The Giro Centre, which will cost £15½ million to build and equip, will be one of the biggest computer complexes in Europe. It will have eleven computers and 365 encoding machines which, operated by skilled staff, will be able to handle more than a million separate transactions a day.

Into the National Giro Centre each working day will flow scores of thousands of instructions from Giro customers transferring credit from one account to another, paying money to and receiving payments from people not in Giro and making deposits to their own accounts.

The Giro forms will be sent to the Giro Centre from all parts of Britain in special different coloured envelopes which indicate to sorters from which of the six geographical sectors into which the Post Office has split the country, they have come. After the envelopes have been sorted into their sections they will be opened and their contents checked manually. The documents will

# UTER COMPLEX

By A. J. SMITH

be totalled to balance the amounts with the lists from remitting post offices and banks. The documents will be batched and control totals produced for the batches. To safeguard the validity of the encoding, check digits will be generated for amounts and customer references. The different types of transaction instructions will then be streamed to appropriate data conversion machines.

Data contained on deposits, payments in and transfers will then be either encoded in characters which are read optically or—if they are unsuitable

for machine reading because they do not conform to the size or quality of paper the machines can handle—keyed direct on to magnetic tape. Payment orders will be encoded in magnetic ink characters, such as used on bank cheques, to ensure compatibility with the commercial banking system. At the encoding and direct keying stage the check digits will be verified by an operator keying the data to be encoded together with the check digits to ensure that the input data is correct. If the operator makes a keying error the keyboard locks.

The forms will then be microfilmed front and back by high-speed cameras, the retrieval code being an eight-digit input serial number imprinted at the time of filming. This serial number will be

OVER

## ... AND THIS IS HOW THE SCHEME WILL WORK

**The National Giro offers seven attractive basic banking facilities both for business at all levels and for private individuals:**

1. *An account holder can make deposits direct to his own account either by presenting cash at the counter of any one of the 22,000 post offices in the country or by sending a cheque, postal order and so on direct to the Giro Centre.*

2. *Payments can be made to Giro account holders by those who do not have Giro accounts by paying cash over a post office counter.*

3. *Transfers of single payments and of regular standing orders can be made between account holders. Transfers will also be possible under the automatic debit transfer system. This will enable the payee to originate a debit transaction if he obtains prior agreement of the payer and National Giro.*

4. *Transfers can be made to the Post Office Savings Bank and the Trustee Savings Banks.*

5. *Transfers can also be made between Giro and the commercial banks.*

6. *An account holder can withdraw up to £20 on demand at a nominated post office and up to any amount within the limit of his holding from any post office on application to the Giro Centre.*

7. *Account holders can make payment to third parties, either in cash by way of the Giro Centre or by Giro cheque sent direct to the payee for paying into a bank account.*

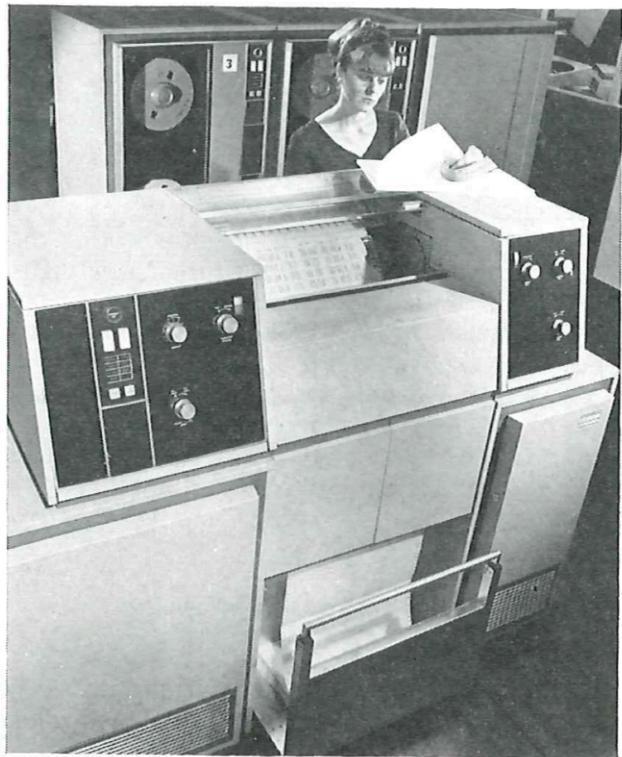
In addition, account holders will be able to

obtain travellers' cheques and foreign currency by completing an order form at any post office counter and purchasing them by Giro transfer or inpayment. Other facilities are likely to be added later if there is a demand for them and so long as they can be operated economically.

To open an account, private individuals complete a form (obtainable from any post office) and send it to the Giro Centre. Business organisations fill in a special form obtainable from the Giro Centre. Each account holder has to make an initial deposit of £5. This deposit may be used for making payments and the account will remain open even if there is a nil balance.

When the initial deposit is received, the Giro Centre sends the account holder a supply of postage-paid envelopes pre-addressed to the Giro Centre and two types of forms pre-printed with his name, address and account number. The transfer/deposit form will be used for making deposits to or transfers from the account and the payment order for making payments out of the system.

The National Giro is primarily a transfer system. All transfers (except to commercial banks) will be free of charge. Individuals who use the National Giro but are not account holders will be charged 9d. for each transaction they make. Payments out of the system will cost 9d. for amounts up to £50 and 2s. for amounts of £50 and over.



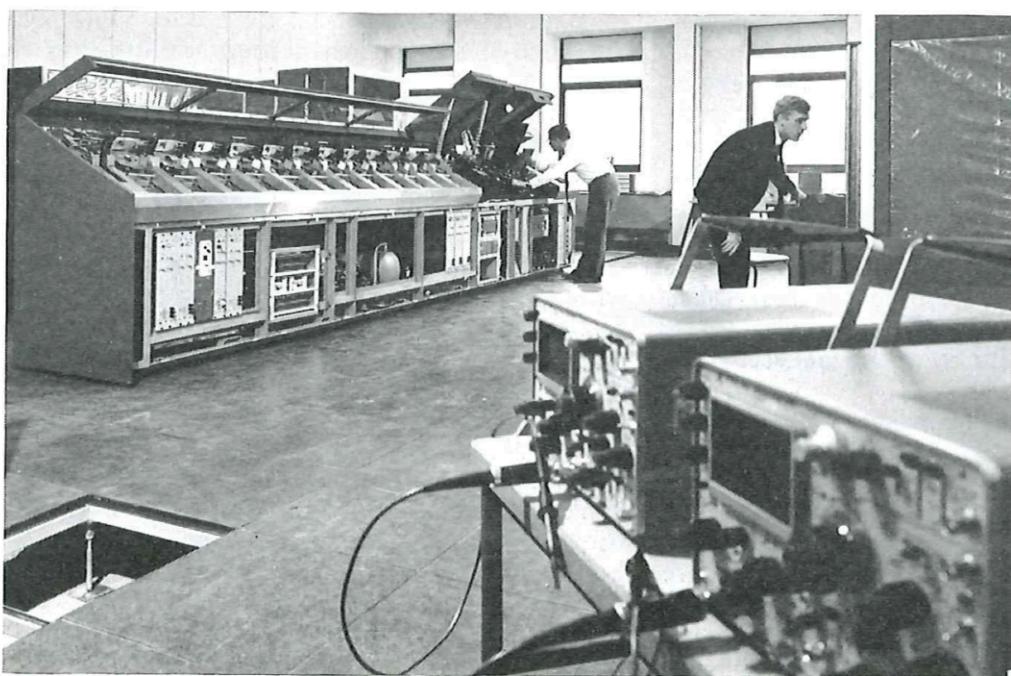
**The line printer unit, part of the peripheral equipment. It has its own control unit and maintenance takes only ten minutes a day.**

transferred to microfilm by way of a data recorder which will also be used to produce microfilm statements for record purposes.

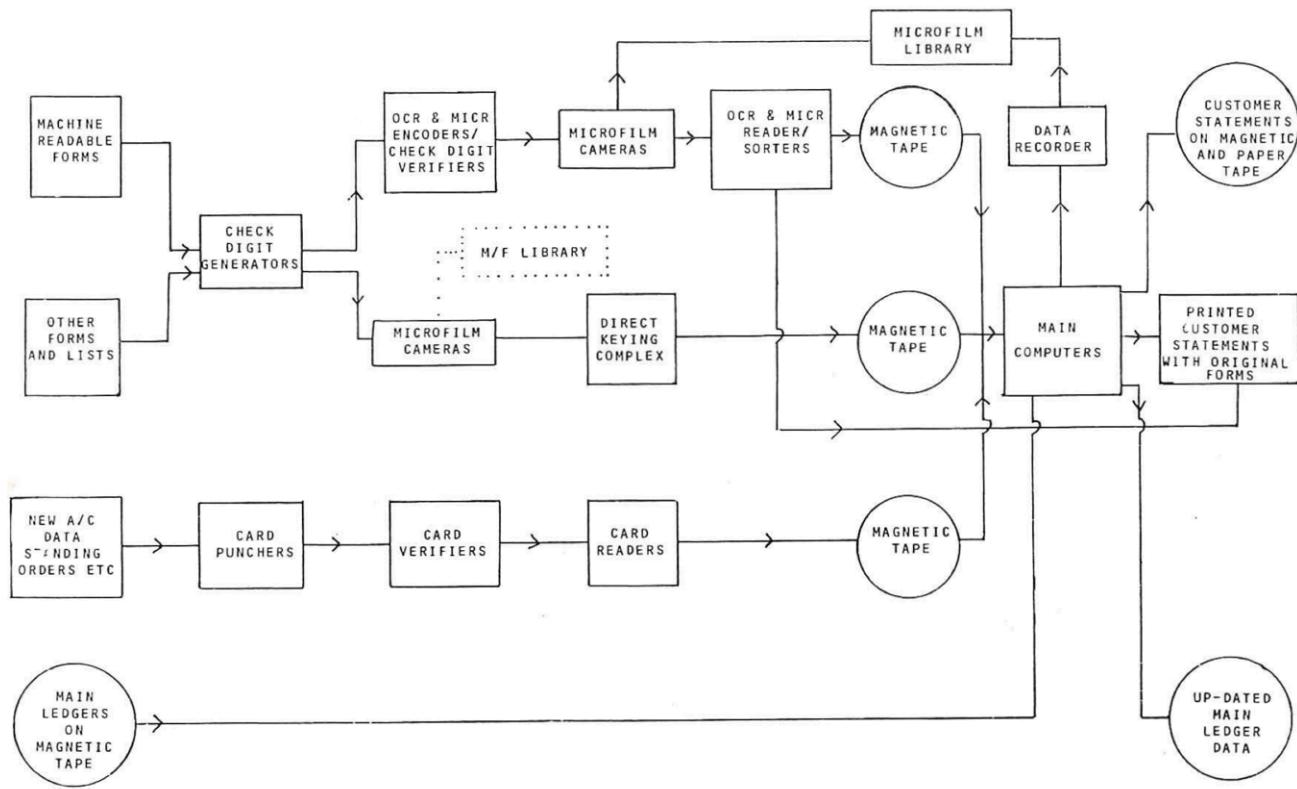
Documents encoded with optical characters will be read, off line from the main computers, from  $\frac{5}{8}$ -inch code lines at the base of the documents by optical readers. When the documents have been read so that data can be written on to magnetic tape for subsequent input to the main computers, a bar code is printed on the reverse side of the documents for sorting purposes.

Forms which are not suitable for machine reading and transfers in list format will be handled by a direct keying system comprising 142 keyboards working to two PDP 9 computers, each with magnetic disc storage. Only one computer will be used to output data to magnetic tape for subsequent input to the main Giro computers and two identical tapes will be produced via the magnetic disc store. The second PDP computer will act as a standby but keep in phase with the active computer ready to be switched into service if the first computer breaks down. Standby disc and tape units will also be provided.

Punched cards will be used for setting up new



**The document transport unit for the electronic retina computing reader being tested at Bootle.**



This simplified flow diagram shows how information for account transactions will be processed at Bootle.

accounts, to file amendments for computer interrogations and standing orders and to provide a useful standby for supplementing other input media.

Once the information has been read from the forms, two processes can follow in parallel. The information can be processed within the computer system to update debtors' and creditors' ledgers and to produce customers' statements of account. At the same time, the forms can be sorted automatically into the account number order of the creditors. The statements will then be printed and associated with the sorted forms to be enveloped and sent by post to account holders.

Business organisations will be able to produce and issue their own Giro stationery so long as it conforms with Post Office requirements in size quality and weight of paper and layout. Up to 20 digits of alpha/numeric customer reference information can be included on the Giro forms in such a way that it can be processed through the system. In this instance, the creditor's statement would then be annotated with the reference numbers he assigns to his debtors, instead of the

debtors' Giro account numbers, and the amounts paid.

Some business customers with their own computers require their statements of account in machine readable form—for example, in magnetic or punched paper tape. Where each creditor receives his statement in one of these forms, data conversion by the creditor will be reduced and updating of his own internal accounts will thus be simplified.

All Giro accounts will be held at the National Giro Centre which will complete all transactions on the day they are received and send account holders their revised statements of account within 24 hours of any deposit or withdrawal.

#### THE AUTHOR

**Mr. A. J. Smith** is a SEO consultant in the Business Relations Division of the Giro and Remittance Services Department. He joined the Post Office in 1956 as a Telecommunications Traffic Superintendent, serving in London Telecommunications Region and in the Tunbridge Wells Area. In 1964 he moved to the Inland Telecommunications Department on promotion to Senior Telecommunications Superintendent and took up his present appointment in 1966.

**An example of the way in which the Post Office helps other Government Departments is the aid it is giving to establish and maintain . . .**

## **A DATA NETWORK FOR SOCIAL SECURITY**

**By D. A. JEFFERY**



**Miss Judy Bartlett inserts an edged punch card into the card reader which automatically transcribes a claimant's identity details to tape.**

**T**HE Post Office is to play a vital part in setting up a new data network aimed at helping the Ministry of Social Security to increase the efficiency and reliability of its services and to reduce administrative costs.

The new scheme, which will be introduced in stages over the next three or four years, will involve linking each of the 800 or so National Insurance local offices over Post Office circuits to

one or other of four large computers. The Post Office will also provide the terminal equipment in the local offices and carry out installation and maintenance work, at least for the initial stage.

National Insurance is very big business, affecting almost everyone in the country. Handling the many millions of claims and ensuring that payments are made quickly make heavy demands on manpower.



**A message tape containing details of a number of claimants is loaded into the transmission set before being fed into the computer. This equipment and that shown on the opposite page will be provided and maintained by the Post Office.**

will serve local offices over a large area of the country.

The new computer scheme will fully justify the costs of automation. Claims will be dealt with at least as quickly as they are under the present system and a great deal of statistical information will be built up for easy reference when required.

Communication between local offices and the computer centres will be speeded and the cost of the new communication links will make the scheme an attractive economic proposition. The amount of data likely to be transmitted daily from the offices to the computer centres could be satisfactorily carried on low-speed (50-baud) data links similar to conventional teleprinter circuits and the proposed data-handling equipment in local offices is similar in certain respects to that which the Post Office is to introduce for telex and private circuits.

Since unemployment benefit is claimed at and paid by Ministry of Labour Employment Exchanges, the Ministry of Labour will also have access to the Ministry of Social Security's data-processing centres. Initially, however, access will be provided mainly on an indirect basis only over the Ministry of Social Security's data links.

The first stage of the scheme will serve about 80 Ministry of Social Security offices and about 50 Ministry of Labour offices in the Greater London Area, as well as one office of each Ministry in Reading. These will all be associated with a data-processing centre at Queen's Road, Reading, the location of which was chosen because of its strategic position both as a postal and telecommunications centre. The locations of the other three computer centres have not yet been decided.

Each centre will have a data-processing system and an output (payments) system. At Reading, the data-processing system will consist of an ICT 1906 computer to which the lines to offices will be connected. When an initial application for benefit is received the relevant contribution particulars will be supplied by the Ministry of Social Security's central record branch at Newcastle. This information will be processed and

**OVER**

To ease these demands—particularly on staff employed at the 800 local offices—and make the most economical use of the staff, the Ministry recently decided to use computers on a large scale to take over a great deal of the routine work involved in determining and paying claims for sickness, unemployment assistance, maternity benefits and similar "short-term" transactions. The computers will be installed at four centres and each

stored in the Reading computer for use when subsequent applications are made.

To ensure that an applicant's National Insurance number—the most important detail of any transaction—is quoted correctly by the office concerned, it will first be recorded, with the addition of two check digits and the claimant's name—as code perforations in paper tape. The tape will be used to reproduce the information in printed and coded form on a card, three inches wide and five-and-a-half inches long.

The code will be punched into the card along one of the longitudinal borders and the card will then be posted to the appropriate local office where it will be retained for use in identifying subsequent input information.

The input will be in the form of teleprinter-code messages so that insurance numbers must always be accurately coded and transmitted. The direct transfer of the information on the card, by means of a card-reading machine to a perforated message tape for transmission to the computer centre at Reading will eliminate much of the danger of human error in transcribing the vital National Insurance number.

To guard against errors during transmission

because of machine or circuit defects, all data will be transmitted in International Alphabet No. 2 code, modified by the addition of a sixth element per character to provide an "odd" parity check. The use of a six-level code will enable all characters to be coded with an odd number of mark elements. The computer will be programmed to reject any received character code which does not conform to this pattern.

The computer will not process any message until all of it has been received and acknowledged and it will not do so even then if two or more coded combinations in the message are errors. The computer will also check message and record format and feasibility and reject both messages and individual records if the particulars are incorrect.

Message transmission from an office will not begin until a "Start-to-transmit" signal is received from the computer. Since the computer's data storage capacity is limited on economic grounds to cater for a lower traffic level than the possible maximum, the computer will regulate the data-input level if the acceptable limit is reached by automatically suppressing "Start-to-transmit" signals. The computer will also be able to arrest a message in transmission without loss or mutilation of characters by sending a signal to the transmitting office.

The output (payments) system—equipment for which has already been installed—will produce an output of postal drafts from nine line-printers operated from an ICT 1904 computer which will be supplied with information transferred on magnetic tape from the data-processing section.

It is expected that between three-and-a-half and four million characters will be transmitted daily to Reading from the London offices. Traffic on each office line connection is likely to vary from four hours a day from busy offices to ten minutes a day from small offices.

Each message tape will be limited to a maximum of about 500 characters (about ten insurance records, each an average length of 40 characters) which will take about one-and-a-half minutes to transmit. This arrangement ensures that interrogatory messages can also be interjected into the data traffic stream without causing undue disruption and that normally a reply to a query can be received within five minutes.

Each Ministry of Social Security office is to be equipped with one on-line transmission set and



An operator at the console of the 1906 computer at the Ministry's data processing centre at Reading.

one or more off-line data-preparation sets. Most Ministry of Labour offices will have data-preparation sets only, the messages prepared on them being sent by hand or post to the nearest Ministry of Social Security office. This equipment will be provided, installed and maintained by the Post Office.

The data-transmission set will consist of a Creed Model 446 six-unit page-printing teleprinter without a keyboard; a data-reader (for perforated cards or tape); and a self-contained control and supervisory unit. This item will be mounted on the new type of Post Office telex table.

Data preparation positions are similarly equipped, except that they can be operated at 75 bauds, compared with 50 bauds for data-transmission. The teleprinters have keyboards and tape reperforating units.

Message tapes are prepared on the data-preparation set teleprinter from the fixed information read off the cards and supplemented by other details of the claim which are inserted from the keyboard. A printed copy of each message will be produced in addition to the tape. It will show data derived from the card-reader in red and data inserted from the keyboard in black. The teleprinter reperforator will punch tape seven-eighths of an inch wide.

Prepared message tapes are inserted in the data-reader of the transmission set and the "prepare" button on the control unit is then operated. This starts the data-reader and teleprinter motors. The subsequent lighting of the "Local Call" lamp indicates that the connection to the computer is established. Depression of an RTT button sends a "Request to Transmit" signal to the computer and lights the local "Computer Control" lamp. Operator control of the message can then be relaxed since the start of the message transmission is initiated only when the operator recognises the "Request to Transmit" signal and returns a "Start to Transmit" signal. Receipt of the latter signal brings the data-reader into operation and message transmission begins.

Message tapes are terminated with an "End of Transmission" character sequence which is detected both by the computer and the local equipment and causes the data-reader to cease functioning. If the computer has no traffic for the station it returns an "End of Transmission" signal to stop the teleprinter and data-reader motors. Incoming traffic is received as page copy.

#### THE AUTHOR

**Mr. D. A. Jeffery** is an Executive Engineer in the Network Planning and Programming Department at Telecommunications Headquarters.



The 1906 computer tape decks at the Reading Centre.

# MONITORING FOR AN IMPROVED OPERATOR SERVICE



An engineer makes adjustments to one of the new monitoring devices at Palmers Green exchange.

For four years LTR has been monitoring staff and service conditions on auto-manual switchboards. As a result new management techniques and a better operator service are emerging.

By H. M. de BORDE

OVER the past 40 years there have been many developments in applying automatic methods to telecommunications. Replacing manual by automatic exchanges—now virtually complete throughout the country—has been going on since 1926, followed later by code dialling and subscriber trunk dialling.

Yet, in spite of these changes, which have immensely increased the proportion of telephone calls which can be dialled, the Post Office still needs to employ some 50,000 telephone operators in our exchanges—more than twice the number 40 years ago.

The reason for this anomaly lies in the growth of the telephone system which is now nearly ten times larger than in 1926. It is the reason, too, why the Post Office is now spending about £43 million a year on operator services—a sum which calls for critical consideration in the interests of economy and productivity.

The management of manually-handled traffic has changed little since all-manual days. Generally,

traffic is received at manual boards and staff deal with it on the basis of records taken at intervals—monthly for overall traffic level and less frequently for incidence throughout the day. The quality of service to subscribers is measured by observations which provide information about speed of answer and other aspects of quality. On-the-spot control of the work of the operating force is carried out by traditional methods of floor supervision.

In 1964 experiments began in North Area of London Telecommunications Region to seek more scientific evidence of the relationship between the incidence of traffic, the level of staff provided and the service achieved. The recording instrument employed was a pen recorder (decibel meter 36A).

The first experiment was to record and study variation in the level of calling signals awaiting answer. This was followed by an experiment in restricting access to the manual board of additional calls after a certain limit had been reached. The need was then felt for an indication of the level of

staffing as a check on deployment of staff. This was displayed on a pen recorder actuated from headset jacks.

The next step was to monitor the arrival of calls by detecting the current pulse from lamp relays. Storage devices were employed to count and display the aggregate of calls over predetermined periods of time. To economise in pen recorders the displays of staff and traffic incidence were combined on one recorder using time division.

Information was now available about the staff provided and traffic offered over short intervals. It next became important to have more immediate information about service results over short intervals. Accordingly, a service monitoring device was introduced to monitor batches of calls at frequent intervals and display the results on a pen recorder in time-to-answer and percentages of calls delayed, again using time division.

The Staff/Traffic Co-ordinator operates quite simply. At intervals of two to three minutes, the pen recorder circuit displaying operators employed is switched for six seconds to the traffic incidence storage equipment, moving to a point indicating the number of new call arrivals during the interval. The time interval selected is that equivalent to the average time value of traffic handled on the switchboard. The traffic incidence then equates to the staff justified by that amount of traffic.

In addition, the count of traffic is recorded on a subscriber's type meter, as is also the result of a check at 36-second intervals of the positions staffed. These meters provide an overall assessment of the levels of traffic offered and of staff hours employed. The selection of a 36-second interval for checking staff provides 100 checks an hour so that staff hours can be read to two decimal places.

To save time in reading meters, meter printers have now been associated with the traffic incidence circuit. These enable the traffic incidence to be recorded in digital form at, say, 15-minute intervals, thus providing an automatic record of traffic in digital form for staffing purposes.

The Service Monitor provides on a trace information about average time-to-answer of the batch monitored and the proportion of calls delayed beyond periods of 10, 30 and 50 seconds.

The circuitry is in two parts. The hunt-and-find element detects the pulse given by the arrival

of a calling signal, locates it on the bank of a high-speed uniselecter and connects it to the storage and display element. The storage circuit records the duration of the calling signal in seconds and stores it in delay categories.

After 10 or 20 calls have been monitored the display element of the circuit is brought into operation. This disconnects the hunt-and-find circuit during the display period.

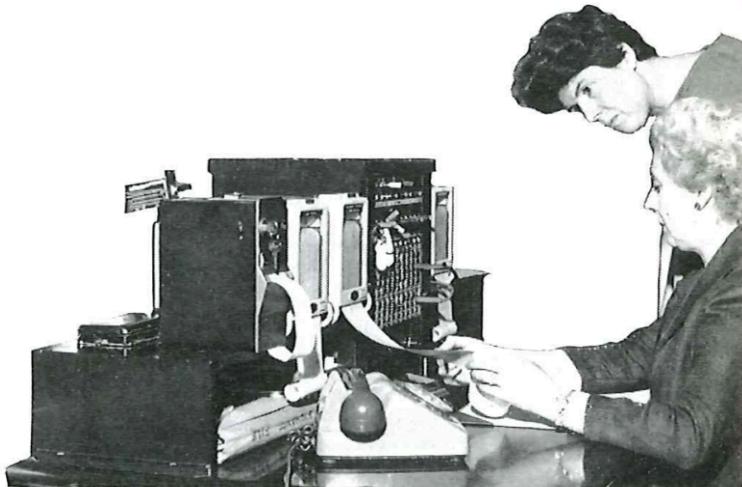
The sequence of display is (1) time-to-answer; (2) calls delayed beyond 10 seconds; (3) after one minute's interval, calls delayed beyond 30 secs; and (4) after a further minute's interval, calls delayed beyond 50 secs. After a complete display sequence, the hunt-and-find circuit is re-opened for a further cycle.

Inevitably, if it is desired to provide frequent indications of the speed of service, some compromise with statistical accuracy has to be made. For example, no call is monitored beyond 50 seconds. The significance of the results obtained lies principally in their comparative value, immediacy and frequency. Importance is attached to the delay figures, which many would regard as reflecting the service more realistically than an average time-to-answer.

In practice, during most of the day, service results are indicated about every five minutes and about 1,500 calls a day are monitored at an auto-manual centre of, say, 30 staffed busy-hour positions. In addition to the pen recorder traces, the results of monitoring are recorded on

**OVER**

**The Chief Supervisor (sitting) and the Section Supervisor discuss the staffing and service situation shown by monitoring devices at Palmers Green.**



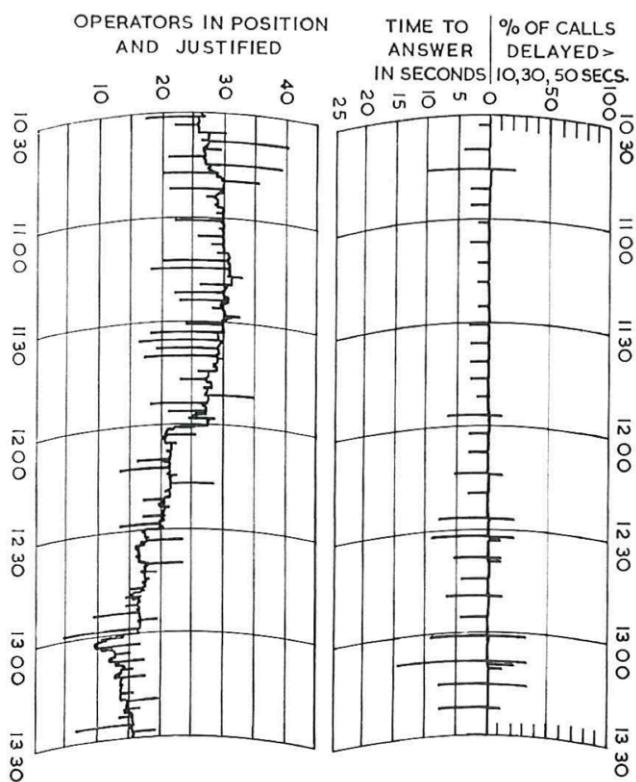


DIAGRAM 1

subscribers'-type meters. A meter is also fitted which records the number of calls abandoned by the caller before answer.

The two devices described are complementary in use and demonstrate cause and effect. Jointly, they provide automatically more information than has ever been available before about the relationship between operator loading and service achieved (see diagram 1). Moreover, in the past, traffic records taken manually have been of limited accuracy and have suffered the disadvantage of indicating traffic carried rather than traffic offered. They have, therefore, always tended to under-rate the level of traffic at peak periods. Similar criticisms can be applied to many systems of record taking both within and outside the telecommunications field, for example, at post office counters.

Success in the use of automatic monitoring devices depends largely on the co-operation of those who use them and although their introduction has been experimental, the Staff Side has

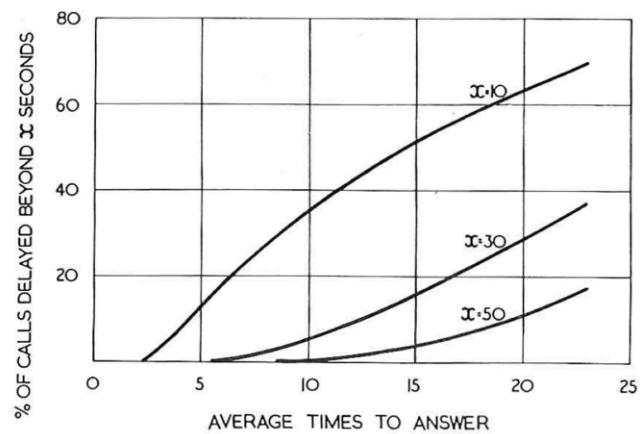
been kept fully informed about all developments from the outset and has willingly lent its co-operation. Discussions have taken place with supervising and operating staff on the use of the devices and their value as tools of supervision.

The information provided by the devices would enable staff and traffic to be aligned both more readily and with greater precision than by present methods. When used at an auto-manual centre, the devices reveal the times at which the service is poor and the staff/traffic situation causing the poor service. They also show the periods when staffing is more than adequate to meet the traffic level. As a result it has been possible to make minor adjustments of duties and meal reliefs leading to improved service.

The need for such changes may be noticed by normal supervision, and no action has so far been taken to replace existing methods of staff revision. But the revelation of the situation on pen recorder traces adds weight to visual observations, particularly when a pattern is repeated. Notes in the exchange diary cannot compete with the precise information obtained continuously and in recorded form.

Much statistical information about the incidence of traffic and the pattern of answering has been brought to light by the new devices. Information obtained on the relationship of speed of answer and calls delayed beyond 10, 30 and 50 seconds reveals, for example, that even when the speed of answer is poor a substantial proportion of calls is answered in less than ten seconds (see diagram 2). It also shows that over lengthy periods of the day the service is good at most auto-manual centres; the conspicuously worst

DIAGRAM 2



service occurs usually when the traffic is rising or falling, and at off-peak times.

The point is often made that the quality of service is not well described by speed of answer figures which define the average but not the variance within the average. The use of the Service Monitor enables one to describe the service in terms of its delay pattern and points the way to more realistic assessment of the service both overall and within periods such as day, evening and weekends.

Interesting facts have come to light about the effect of variations in operator load on service rendered. A sharp worsening of average time to answer takes place while the load is increasing by up to 50 per cent—thereafter it changes very little. This is because of (1) the increasing number of abandoned calls and (2) the substantial proportion of newly arrived calls which are given precedence.

Analysis of the order in which calling signals within a batch are answered by operators has in fact shown that the longest waiting signal has less than half the chance of being answered first as has the most recent arrival. Operators are, of course, taught to answer calls in order, but it may well be that on a busy switchboard they find difficulty in determining precedence and tend to be attracted by a fresh arrival.

Another automatic monitoring device with which North Area has experimented is the Regulator. The need for this was felt when the first device, which monitored the level of calling signals awaiting answer, was introduced. It became evident that on occasions the build-up of signals was so great, and lasted so long, that many calls were unlikely to be answered within a minute or more. Furthermore, in such conditions, the newly-arrived calling signals were often given precedence over those already long delayed.

Using a contact ammeter fed from lamp relays, an experiment was tried out by applying the engaged condition to 100 level circuits on the manual board whenever the number of waiting signals rose to a pre-determined figure. The engaged condition this applied was maintained until the waiting signals had been cleared. Strict watch was kept on the duration, frequency any total extent of operation of the Regulator by means of meters and a pen-recorder. Much information of interest was gained and the experiment is continuing.

While use of the Regulator to limit access of traffic by an engaged signal or verbal advice is not accepted procedure, experience during trials suggests that in practice subscribers accept its restriction with less annoyance than arises from the lengthy delays associated all too often with peaky traffic.

In relation to the design of queueing systems on switchboard positions of the future the experiments in North Area could be significant. For example, a level of waiting signals of, say, six at a sleeve-control board of 30 positions is the most that can be admitted without serious degradation of the service.

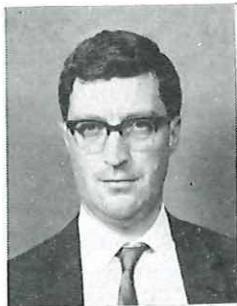
The Staff/Traffic Co-ordinator and the Service Monitor could help to improve productivity and realise substantial economies. The simplified systems of record taking they produce would mean a saving of clerical and traffic office time in preparing staff revisions and a better co-ordination of staff to traffic. Traffic records would be available continuously, as would also the service results achieved, and staffing adjustments could be made as and when required instead of at the present lengthy intervals. The improved knowledge of traffic and service conditions at automanual centres which use of the devices would produce should also lead to negotiation on staffing questions on a more factual basis and ease the attainment of service and productivity targets.

The development of these telemetering devices has been widely discussed within the London Telecommunications Region at conferences of Telephone Managers and others directly involved in the management of auto-manual centres. In August, 1967, an LTR Study Group recommended a more widespread use of the devices.

In the past automation has served principally to replace telephone operators. With these latest innovations, operators and automation will be allied with the objects of achieving a better service for our customers and more stable operating conditions for the staff.

#### THE AUTHOR

**H. M. de Borde** joined the Post Office in 1926 as Assistant Superintendent of Traffic. In World War II he was seconded to the Training Branch of the Personnel Department where he became Chief Executive Officer. He returned to London as Deputy Telephone Manager of N.W. Area and then Telephone Manager in North Area. He is now attached to the Director's Office, LTR.



Last October the Government asked the National Board for charges for its services. Here, reported in brief, are the results

# THE PRICES AND

Above: Mr. Ralph Turvey, leader of the Board team which inquired into Post Office charges.

**I**N many minor ways and a few ways that are not so minor, we agree that criticisms are justified. But we think that the very substantial merits of the Post Office should be recognised. In spite of its defects, we have been favourably impressed with its efficiency and with its high regard for the public interest."

This is the summing up by the National Board for Prices and Incomes in its report on the Post Office proposals for increases and readjustments in its tariffs.

The proposals were made to maintain the overall profitability of the service; to achieve the economic and financial objectives laid down by the Government (on the telecommunications service a return of  $8\frac{1}{2}$  per cent on net assets after historical depreciation but before interest and supplementary depreciation); and to bring some prices more closely in relation to costs.

The Board recommended considerable modifications to the Post Office proposals. The Post Office wanted to raise most of the extra revenue required by increasing telephone rentals to £20 a year for all exclusive lines, compared with the present £14 for a residential line and £16 for a business line; and by giving residential subscribers the option of changing to a shared line for which the rental would be increased from £12 to £16 a year.

The Board was not satisfied that these proposals were soundly based on long-term marginal costs and recommended that for the time being increases should be limited to an additional £2 for residential subscribers.

The Post Office proposal to remove the requirement for new residential subscribers to pay one year's rental in advance was accepted but the Board suggested that the maximum connection

charge should be raised from £10 to £20, with corresponding increases over the rest of the scale.

On call charges, the Board said: "most of the extra revenue required should be obtained by varying call charges in such a way as to increase the differential between hours of peak traffic and other times. It would be possible to raise the revenue required by increasing some calling rates at peak hours and at the same time making some reductions in charges for cheap-rate trunk calls.

"The effect of our proposals would be to increase the incentive given by the tariffs structure towards fuller utilisation of the system," says the Report. "This will increase the efficiency with which resources are used . . . experience may show that there is room for even greater differentials and we recommend that when telephone tariffs next have to be re-cast (perhaps in 1971) the matter should be re-examined.

The Board had the following comments to make about the telecommunications services:

## Forecasting Methods

● The effort being put into forecasting should be substantially increased. More could be done to improve forecasting by using more sophisticated econometric techniques.

## Marketing

● *The quality of advertising and selling that has been attempted has often been disappointing and sometimes ineffective. A start is now being made on a new and more positive approach but much more needs to be done to make the whole organisation at all levels far more sales conscious.*

● There is no doubt about the possibility of stimulating demand for telephones: the problem is rather one of obtaining the resources to meet it... The Post Office has not attempted any major sales promotion campaign since World War Two... there is considerable scope for selective geographical promotion. The waiting list arising

# INCOMES REPORT

from shortage of equipment occurs at only about 20 per cent of the 6,000 exchanges: spare capacity exists at the remaining 80 per cent. The problem is one of stimulating demand in specific localities where spare capacity is expected to exist without stimulating demand where it cannot be met.

● "We recommend that the Post Office should start now a selective marketing campaign to promote sales in areas where existing capacities are under-utilised."

● The Report expresses concern that the public does not have sufficient knowledge of available facilities and services. The only sources available to the average subscriber were the telephone directory and the dialling code booklet which outline only some of the major services. None of the many items of telephone equipment available were listed in the ordinary directory and nor was any number given from which information about them can be obtained. Probably few subscribers knew that a Sales Office exists in every Telephone Manager's office.

"We recommend that this number should no longer be treated as ex-directory; it should be prominently displayed at the beginning of every telephone directory."

● Details of additional facilities and items of equipment should be made available to every new subscriber and periodically drawn to the attention of existing subscribers.

● Virtually nothing had been done to promote the sales of classified directories and of directories for other areas. The Board welcomes the fact that classified directories will soon be issued to all subscribers since this may stimulate demand for local calls and help to reduce the number of directory inquiry calls, while providing a profit from the sale of advertising.

● Advertising and sales promotion of the telex service should also be greatly increased and, as part of the sales campaign, the Post Office should consider reducing prices.

## Efficiency and Productivity

● "In general we are satisfied that the Post Office is highly conscious of the importance of continually examining every aspect of its organisation and operations to maintain and improve efficiency. But there is scope for further improvements. We recommend that consideration be given to carrying out studies by independent management consultants, at least in selected areas of the telecommunications service, on the lines of the work done by McKinsey and Co for the postal services."

● "The completion of conversion of manual exchanges to automatic working and the extension of STD, the introduction of computers and a wide range of improved engineering methods are estimated to save over 40,000 staff in the five years 1967-72. Improved operational efficiency from schemes already proposed should save a further 30,000 staff. During this period the objective is to increase the size of the telephone system by 50 per cent with no overall increase in staff. This represents manpower productivity of about 11 per cent a year on average—a substantial acceleration of what has been achieved in the immediate past. Delays either in procuring the technical means or in achieving productivity projects would place the target in jeopardy."

● "By comparison with the postal service, these figures are impressive but we suspect that if telecommunications were subjected to the same efficiency studies as the postal services have been over recent years the Post Office would find there is a larger productivity potential than it now expects to achieve. We are satisfied, however, that no major improvements can be achieved in time to avoid the current need for increased revenue."

## Costing

● In setting tariffs for individual services it is necessary to adopt long run marginal costs as a basis, but to set the actual tariffs so as to ensure that total revenue is sufficient to enable the Post

OVER

Office to meet its financial targets while ensuring the most effective utilisation of resources.

This approach should be consistently followed for the establishment of future pricing policy.

*"The Post Office should set up a team of engineers, statisticians, economists, operational researchers and cost accountants to undertake the necessary work in order to identify the structure of long run marginal costs."*

## **Telegram Service**

- Use of the inland telegraph service has fallen

from about 65 million telegrams in 1946 to about 10 million in 1966. The forecast for 1971 is about 8 million... In 1966-67 the accounting loss was £2.6 m. on an income of £3.3 m and this position will continue over the next four years with an annual accounting loss of £3 m... There is no possibility of making the service pay... (and) it is unreasonable that it should continue to be subsidised by other areas of the telecommunications service.

*The service should either be treated as a social service and financed by an Exchequer grant or abolished, with special arrangements being set up for transmitting "life and death" messages.*

# **THE NEW TARIFFS**

**T**ELEPHONE trunk charges will be increased on 1 October by about 25 per cent during a new peak period between 8 a.m. and 6 p.m. on Mondays to Fridays.

A new intermediate rate, slightly lower than the present full rate, will operate on Saturdays between the same hours and a cheap rate, longer than the present one, will apply throughout the night and all day on Sundays.

The new charging structure means, for example, that a three-minute trunk call, now costing 1s. in the peak period, will in future cost 1s. 6d. But in the cheap rate period it will cost only 6d. compared with the present 9d. Charges for local untimed calls will remain unchanged but subscribers on STD exchanges will pay 2d. for four minutes instead of for six minutes during the peak period.

Connection charges will also be raised from a maximum of £10 to £20 and rentals for residential lines will be increased by £2 a year. There will also be increases in the charges for alarm calls (from 6d. to 2s.) transfer charge calls (from 3d. to 6d.), personal calls and credit card calls.

Charges for heavy-type and additional entries in telephone directories will go up as will rentals for external extensions, private

manual and automatic branch exchanges and some miscellaneous equipment and apparatus. A new tariff structure and new facilities will be introduced for inland private circuits; a telex connection charge of £10 will be levied in future and call charges will be adjusted; wireless telegraphy licences will cost more.

These are the main changes in telecommunications tariffs recently announced by the new Postmaster General, Mr. Roy Mason. They will bring in an extra revenue of £40 m. a year which is needed, said Mr. Mason, "to help finance the huge capital programme which must be undertaken to improve the service for existing users and to give the country the telecommunications service it needs."

Mr. Mason said the Post Office had accepted the National Board for Prices and Incomes' recommendations in principle. But it did not accept the proposal for three different rates for trunk calls during a week day.

*\*The new tariffs are the first significant price increases for seven years. Rentals were last increased in 1961 and some charges for telecommunications services and facilities have been held steady since the 1950s. Overall prices have remained stable for the past five years—a period when retail prices of goods and services generally rose by some 18 per cent.*

# ROBIN HOOD TO THE RESCUE



Archer David Farrer aims for the far bank.

**T**HREE are more ways than one of restoring a telephone link but few more unusual than the method recently used at the Cumberland village of Langwathby.

The trouble began when flood waters swept away the Langwathby Bridge across the River Eden, cutting off the telephone lines to 250 subscribers in the village. Post Office engineers were stumped for an answer to the problem of how to restore the link across the 80 yards of swirling waters.

Then someone, remembering Robin Hood, had a bright idea: try a bow and arrow. So they sent a car for Mr. David Farrer, a notable local archer and son of a former Cumberland county

champion archer and GPO technician, Mr. Harold Farrer.

Armed with one of his favourite bows and a sheaf of arrows, Mr. Farrer took up position on the river bank and, tying a ball of string to the arrow shaft fired across the river.

Four times the arrows plunged into the river: the string behind them was too heavy. On the fifth attempt, after substituting for the string some lightweight fishing line borrowed from a local angler, Mr. Farrer shot his arrow into the air and landed it on the far bank. The fishing line, which was attached at its far end to the telephone lines, was hauled across and the link was restored.

\* \* \*

## A new radiotelephone



This is the new 5-watt, all-transistorised VHF radiotelephone recently introduced by Cossor Electronics Ltd.

Very compact—it measures only  $10\frac{1}{2}$  ins wide,  $2\frac{1}{4}$  ins high and  $5\frac{7}{8}$  ins deep—and highly reliable, it is designed to meet the needs of many business firms for radio communication. It provides up to six channels.

## THE NEW PMG

**The new Postmaster General, Mr. Roy Mason, MP, is a Yorkshireman who began work at the age of 14 as a coal miner.**

Aged 44, married and with two daughters, Mr. Mason was a branch official of the National Union of Mineworkers from 1947 until he was elected to Parliament in 1953.

In the 1955-56 session of Parliament he introduced a Bill to raise the amount that people who had suffered industrial injury could earn without loss of benefit or hardship allowances. In October, 1964, he became Minister of State (Shipping) at the Board of Trade in which capacity he set in train the reorganisation of Britain's ship-building industry.

In January, 1967, Mr. Mason became Minister of Defence (Equipment), the first Ministry of its kind and a post he held until his appointment as PMG on 5 April this year.

One of the youngest Postmaster Generals in the 300-year-long history of the Post Office, Mr. Mason has been opposition spokesman on avi-



**Mr. Roy Mason  
former miner and an MP since 1953.**

ation, the Post Office and the British Broadcasting Corporation.

Mr. Mason's predecessor, Mr. Edward Short, has been appointed Minister of Education and Science.



## A new telex centre

A new telex centre which will have an ultimate capacity of some 40,000 inland lines is being planned for London on the site of a former pickle factory in South Lambeth Road.

It will cost over £2 million to build and contain equipment worth about £4 million. It is planned to be brought into service by the end of 1973 or the beginning of 1974.

When completed, the new centre will become the largest gateway for telex messages coming into and going out of Britain and also provide local subscriber services.

At present, London has only one telex centre—at Fleet Building. This has a capacity of 12,000 subscriber lines and handles all London's internal telex services and all Britain's overseas telex services. In spite of extensions which are being made, it is nearing saturation point.

To meet increased growth, a fully-automatic

telex centre—with a capacity of 10,600 subscriber lines and housing a large international telex exchange—is being brought into service in 1969 at St. Botolph's, Houndsditch.

The South Lambeth centre will be nearly four times bigger than the St. Botolph's centre and its international capacity larger than Fleet Building and St. Botolph's combined.



*Three more countries—bringing the total to 133—were recently added to the growing list of places with telex links with Britain. They are Gambia, Cuba and Guatemala.*



Orders for telephone service in the six months ended 31 March, 1968, totalled 625,857 compared with 510,691 in the same period a year earlier. Just over 93 per cent of orders for service placed in March, 1968, under the recently-introduced appointments plan were completed on the day named by the customer.

**OVER**

## THESE TWO NEW DEVICES SIMPLIFY TESTING

**The No. 74308 Oscillator. It is portable and weighs only 40 lb.**



**TWO new instruments which simplify testing procedures on a wide range of telephone transmission systems have recently been introduced.**

Known as the 74308 Oscillator and the 74309 Selective Level Measuring Set (SLMS), they span the frequency range 250 Hz to 1,620 kHz and can be used on audio, open-wire, balanced-pair and coaxial systems up to 300 circuits.

They have been designed to eliminate unnecessary switching during the testing of a system and the five frequency bands have been chosen for this purpose. Thus, audio and broadcast frequencies are covered in one band, coaxial supergroup No. 1 in another, basic supergroup No. 2 in a third and so on. Similarly, three output impedances are available to cater for the requirements of different systems.

An automatic tracking signal from the oscillator is used to obviate manual tuning of the SLMS when loop measurements are made. During end-to-end measurements, or when an external signal source is used with the SLMS, an automatic frequency control circuit is provided. This can be switched in so that when the SLMS has been tuned in to the signal it will remain tuned even if the signal drifts by as much as plus or minus 300 Hz from its original frequency.

In addition to making highly selective in-channel measurements in the presence of traffic in adjacent channels, the SLMS can also make wideband measurements—for example, for locating faults on carrier systems taken out of service. The oscillator has a slow-motion drive and a built-in frequency circuit for checking the calibration at intervals throughout the range.

Both instruments, produced by Standard Telephones and Cables Ltd., are portable and operate either from AC mains or an external DC supply of 19 to 21 volts.



*The results of the 1967-68 IPOEE Essay Competition were as follows:*

*£6 6s. and Institution Certificate: Mr. I. M. Hogg, TO, Aberdeen.*

*£3 3s. and IPOEE Certificates: Messrs. M. J. Johnson, T 11A, Newcastle; P. J. Povey, TO, Taunton; J. Morrison, TO, Dundee; R. J. Spring, TO, Birmingham.*

*Institution Certificates of Merit: Messrs. D. E. Coles, TO, Birmingham; J. J. Webster, TO, Edinburgh; M. J. Boomer, TA 11A, Newcastle; A. J. Fryatt, Trainee Technician, Ipswich; J. G. Wardle, TO, Birmingham.*

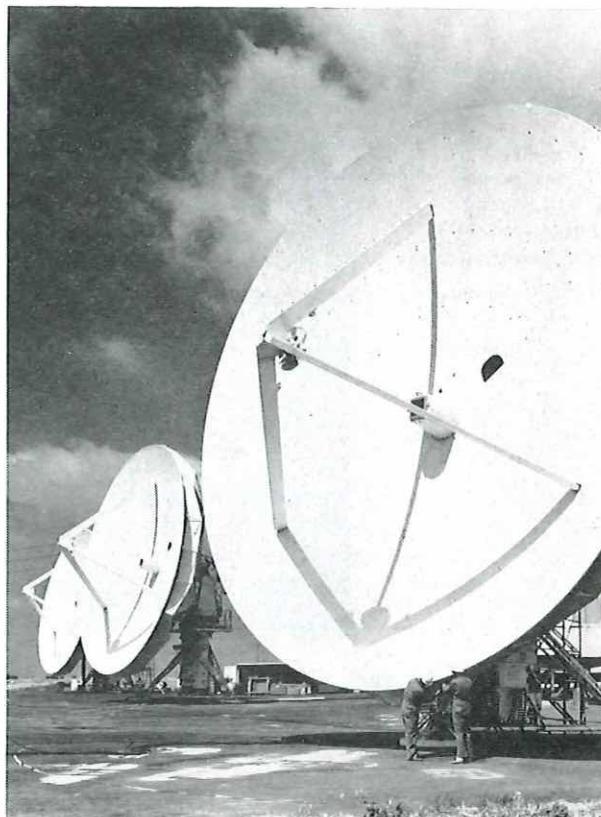
# THESE EARTH STATIONS GO BY AIR

These three satellite communications ground-link terminals—the largest in the world—are air transportable.

They are part of the world's first global military satellite communications network being developed by the United States Army Satellite Communications Agency. Thirteen of them are already transmitting and receiving voice and teletype messages and photographs at sites in the Southeast Asia-Pacific area, in the United States, Africa and Europe.

The United States Forces are using them in conjunction with 17 operational near-synchronous satellites which have been launched by the US Air Force.

Each terminal has a 40-ft diameter antenna mounted on a pedestal and housed in a protective radome. Support equipment is carried in 30-ft long mobile vans and power is provided by diesel generators.



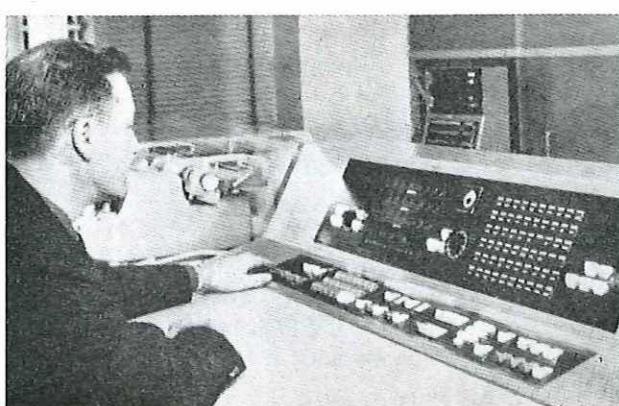
## BELGIUM'S FIRST ELECTRONIC EXCHANGE

Belgium's first electronic telephone exchange to go into public service was recently opened in Antwerp.

It has a capacity of 1,000 lines and an electronic brain which controls and directs calls. Local calls

are set up almost instantaneously by very high-speed electronic switching. Subscribers using several lines can be called at one number, even if they have numbers in different parts of their offices. Calls are metered on a magnetic drum which is read automatically.

The new exchange is said to be fully compatible with existing electro-mechanical exchanges in Belgium. It consists of several autonomous groups, each with a specific function. All groups use removable electronic plates with printed circuitry and there are only seven different types of plates. The speech circuit is set up by means of sealed reed relays. Faults are automatically located through a control console.



This is the console position in Antwerp's—and Belgium's—first electronic exchange.

# THE FIRST LINK IS LAID

The first section of the South Africa to Portugal telephone cable project—between Cape Town and Ascension Island—was completed on 11 March by the Cable and Wireless Ltd cable ship *Mercury*.

The 6,000 nautical-mile cable from Cape Town to Lisbon will carry 360 simultaneous two-way telephone conversations. It will have intermediate landing points at Ascension Island, Cape Verde Island and the Canary Islands from where some channels will inter-connect with Spain. At Lisbon it will join a high-capacity cable to be laid from Portugal to Cornwall. The entire project is expected to be completed by the end of 1968.

**Mercury** manoeuvres off Ascension Island to pick up the shore end cable.

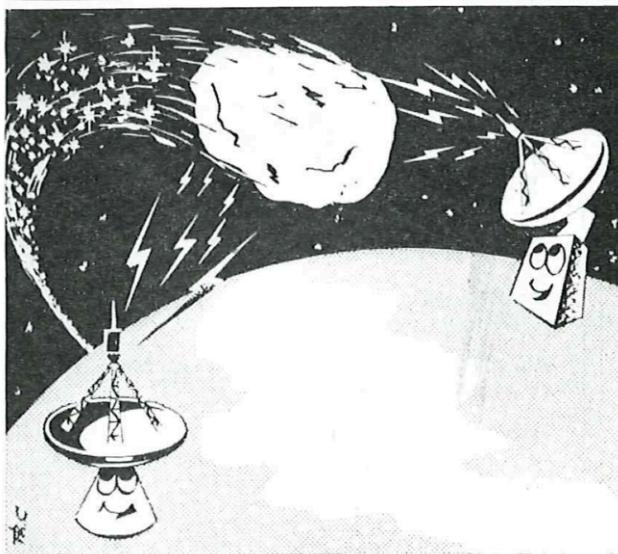
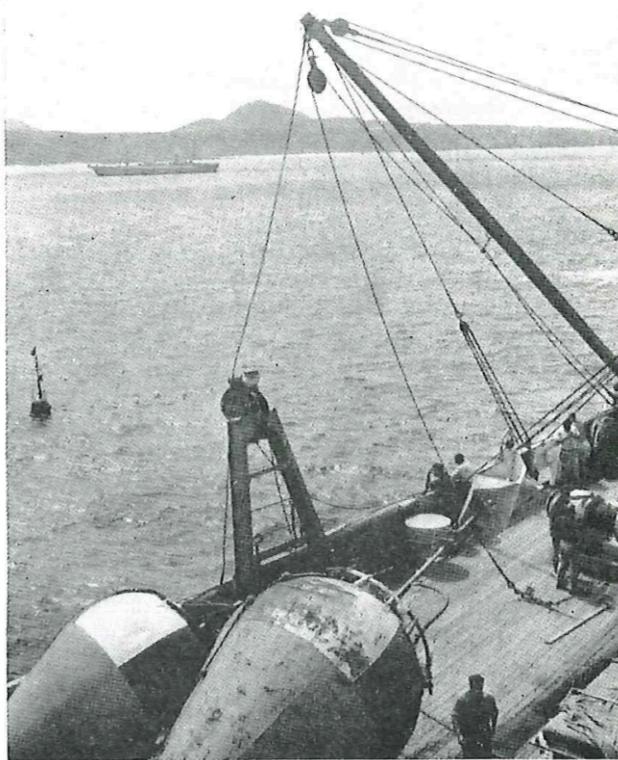
## Bouncing messages off meteors

A report from Moscow describes a novel plan to use radio-communication by meteor in the Soviet Arctic.

The system, says the report, will depend on the reflection of radio waves by the trails left behind meteors travelling several hundred miles above the earth.

Meteor transmission has one great advantage over conventional radio transmission systems, which depend on reflecting radio waves from the ionosphere, because it is not affected by the periodic disturbances of the ionosphere.

Because meteor trails are relatively rare and brief, the meteor transmission system would not operate instantaneously. Information would be stored in a memory unit, ready for transmission at a fraction of a second's notice. When a suitable trail is traced the message would be automatically transmitted at very high speed and using high frequency signals.



The first direct telephone circuit between West Germany and Tunisia was opened recently. It runs from Frankfurt-am-Main, through Switzerland and Italy and by way of a submarine cable to Tunis.

# Telecommunications Statistics

	Quarter ended Dec., 1967	Quarter ended Sept., 1967	Quarter ended Dec., 1966
<i>Telegraph Service</i>			
Inland telegrams (including Press, Railway Pass, Service and Irish Republic) .. .. ..	2,345,000	2,634,000	2,375,000
Greetings telegrams .. .. ..	550,000	713,000	573,000
Overseas telegrams:			
Originating U.K. messages .. .. ..	1,837,000	1,808,000	1,780,000
Terminating U.K. messages .. .. ..	1,842,000	1,812,000	1,798,000
Transit messages .. .. ..	1,665,000	1,520,000	1,506,000
<i>Telephone Service</i>			
<i>Inland</i>			
Net demand .. .. ..	206,000	182,000	163,000
Connections supplied .. .. ..	207,000	181,000	176,000
Total orders in hand .. .. ..	219,000	219,000	220,000
Total working connections .. .. ..	7,248,000	7,121,000	6,836,000
Shared service connections (Bus./Res.) .. .. ..	1,376,000	1,364,000	1,346,000
Effective inland trunk calls .. .. ..	269,988,000	260,099,000	233,467,000
Effective cheap rate trunk calls .. .. ..	59,152,000	60,985,000	50,291,000
<i>Overseas</i>			
European: Outward .. .. ..	*2,437,000	*2,412,000	2,102,000
Extra European: Outward .. .. ..	*218,000	*218,000	212,000
<i>Telex Service</i>			
<i>Inland</i>			
Total working lines .. .. ..	21,000	21,000	19,000
Metered units (including Service) .. .. ..	61,220,000	57,508,000	49,000,000
Manual calls (including Service and Irish Republic) .. .. ..	30,000	†27,000	29,000
<i>Overseas</i>			
Originating (U.K. and Irish Republic) .. .. ..	*3,680,000	*3,680,000	3,228,000

\*Estimated figures. Figures rounded to nearest thousand.

†Amended figure

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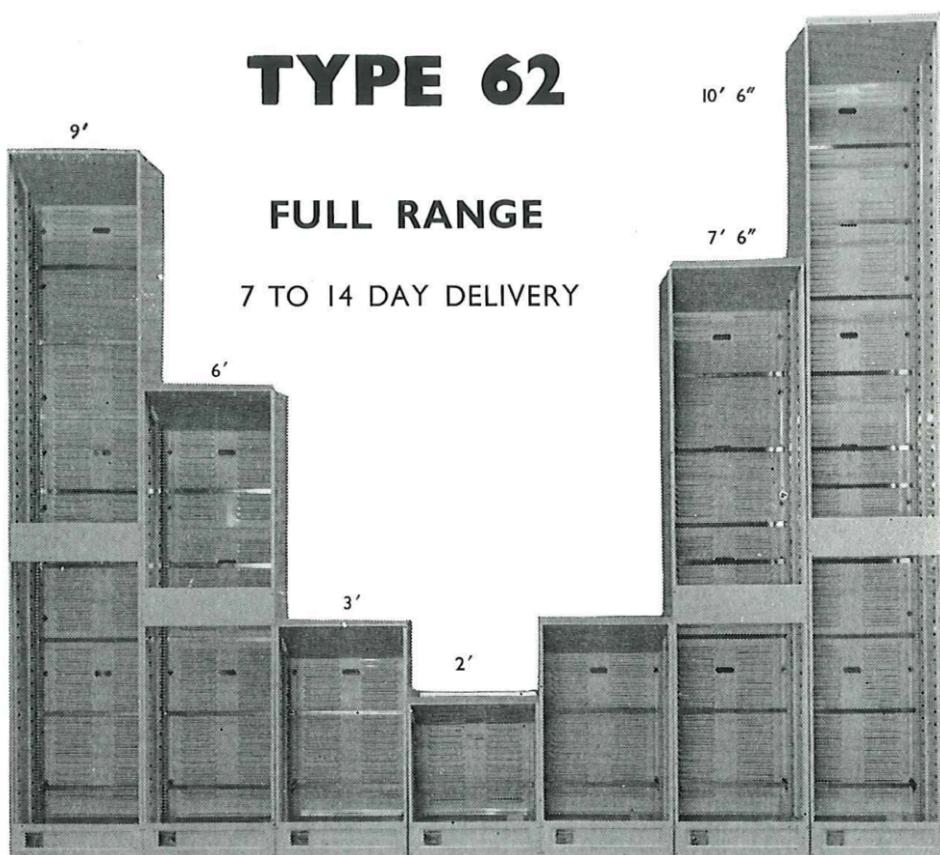
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**Correspondence.** Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, GPO Headquarters, St. Martin's-le-Grand, LONDON, E.C.1. Telephone: 01-432 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co.".



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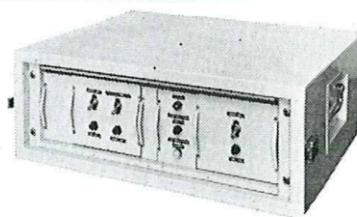
## HIGH PRECISION MECHANICS

FOR INSTRUMENT ELECTRONIC  
AND AUTOMATION INDUSTRIES

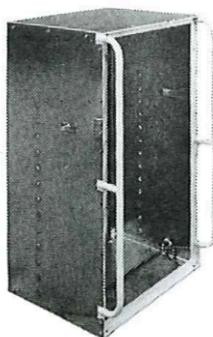
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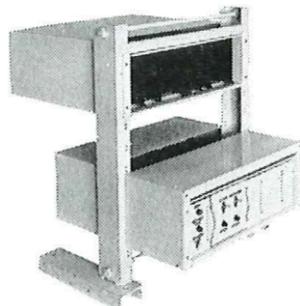
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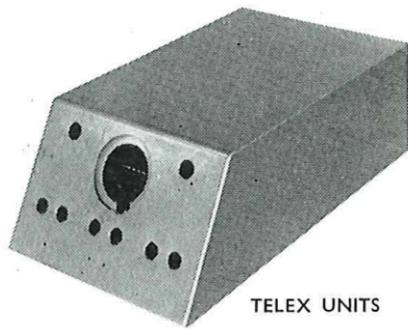
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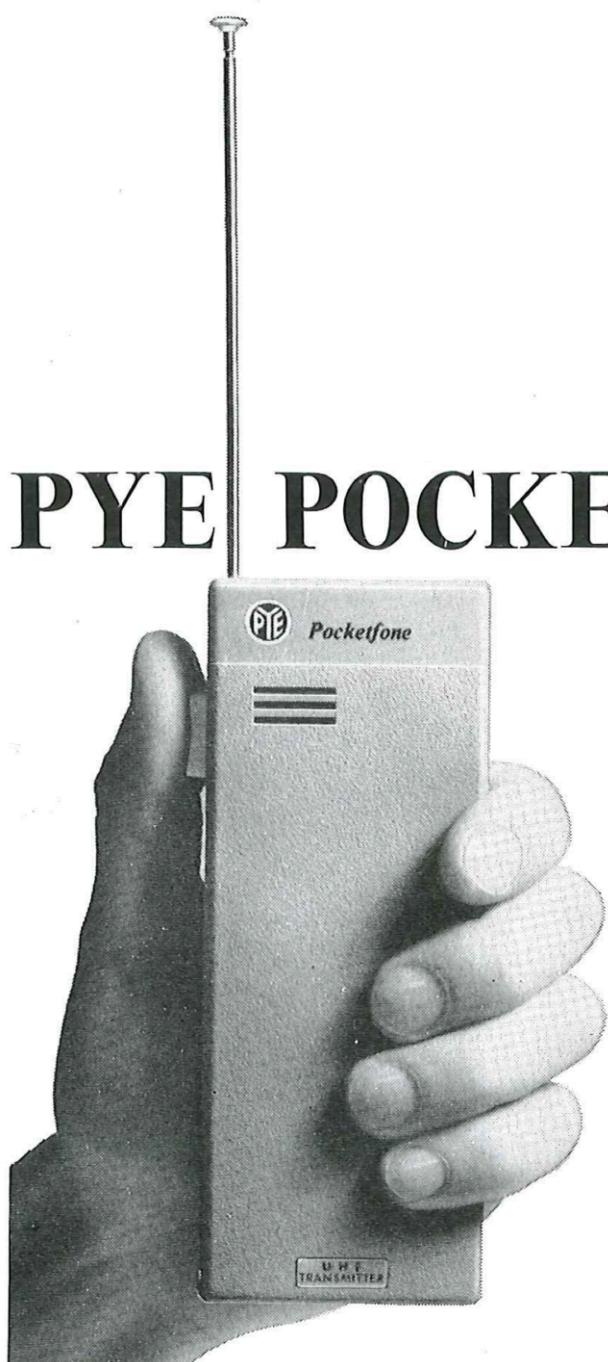


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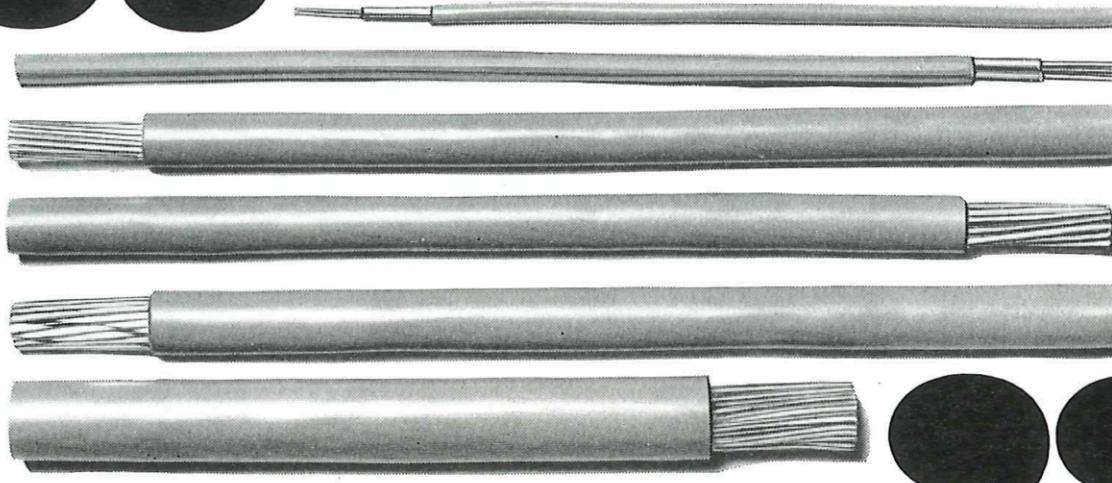
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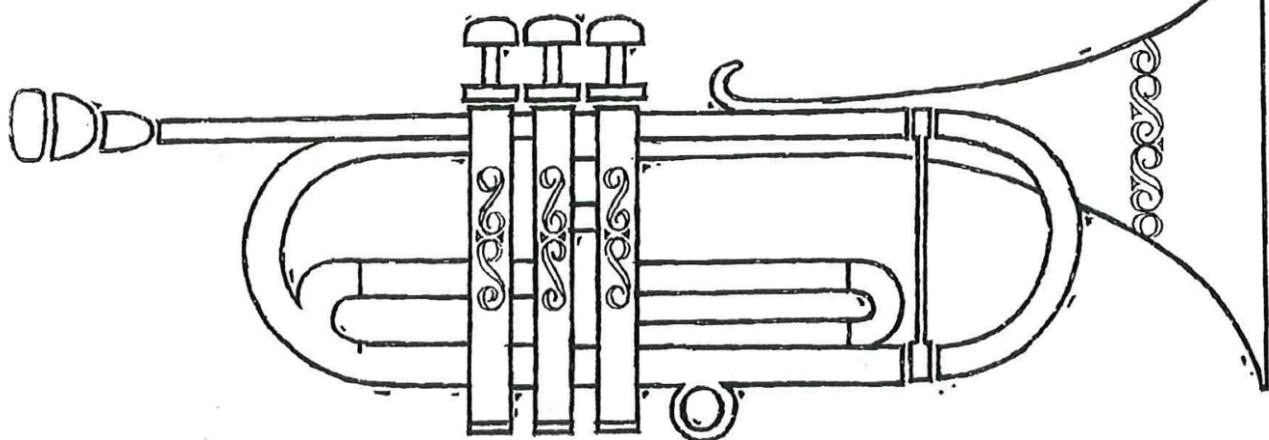
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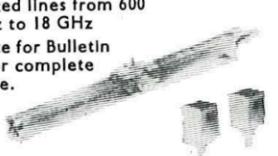
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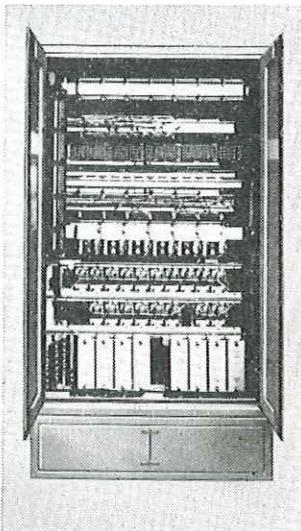
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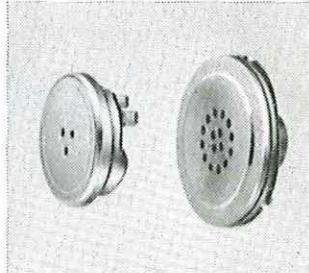


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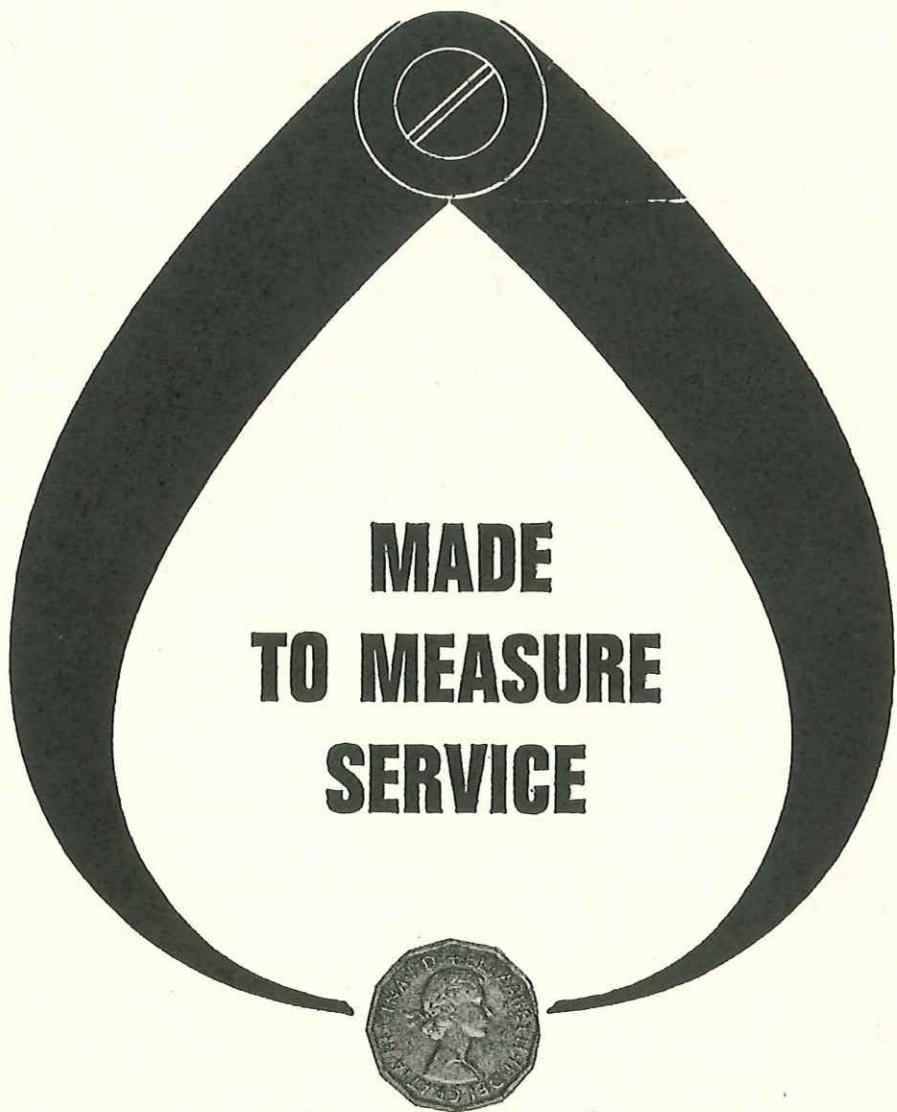


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